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OBSERVATIONS ON THE REPRODUCTIVE BIOLOGY AND GROWTH OF THE WATER MONITOR *(VARANUS SALVATOR)* AT THE MADRAS CROCODILE BANK

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ABSTRACT: Reproduction in the water monitor lizard *Varanus salvator* (Laurenti, 1768) started in 1987, and within a year (1987 to 1988) seven clutches were produced with an internesting interval of 3 months. The average clutch size was 13.8, size and weight of eggs varied considerably even within one clutch. Viability of each egg was determined by candling. The incubation period was temperature-dependent, sexing at hatchling and yearling stages proved to be difficult.

The water monitor *(Varanus salvator)* is one of the most widely distributed monitor lizard species (Mertens, 1942b). In India, it is now restricted to the mangrove areas of Bhitarkanka in Orissa, Sunderbans of West Bengal, and the Andaman and Nicobar Islands (Whitaker, 1978; Das, 1988). A considerable number of publications on its reproductive biology exist (Schmidt, 1927; Vorstmann, 1928; Meer Mohr, 1930; Honegger, 1971; Kratzer, 1973; Anon., 1978; Vogel, 1979; Anon., 1980, 1980a; Biswas & Kar, 1981; Bowers, 1981; Groves, 1984; Gaulke, 1989, in prep.). But, most of these rely on a single clutch, either detected in the field, or laid (mostly by females that were gravid when captured) in captivity, and therefore give very limited information. No comprehensive study on its breeding biology has been conducted so far.

Water monitor populations are rapidly decreasing all over their natural range (Luxmoore & Groombridge, 1989), due to hunting for skin, and to a lesser extent, killing for meat and other products (Das, 1989), habitat destruction, or just killing out of ignorance. A detailed knowledge of the reproductive biology of this species is urgently required to formulate effective protection and management requirements.

MATERIAL AND METHODS

In October 1986, the Madras Crocodile Bank acquired 3:3 adult water monitors from the Nandankanan Biological Park in Orissa. These animals were wild caught from the Bhitarkanika Wildlife Sanctuary, Orissa in north-eastern India. At the Crocodile Bank they were housed in a circular enclosure with four small ponds, climbing branches, vegetated hiding places and an exposed sandy section. Food offered daily *ad libitum*, comprised small fish, rats, ocypod crabs, beef and frogs.

Eggs laid were immediately removed from the nest after marking the tops of each egg with a pencil. This was done to maintain the same orientation throughout handling and incubation. Eggs were wiped clean of sand and each egg was measured, weighed, marked, and viability of each egg determined using a candling light, (comprising a table lamp that is covered except for a small hole, allowing a thin beam of light to pass through) to look for the presence of subembryonic fluid. Eggs without the subembryonic fluid were marked as infertile and kept with other eggs in an incubator and later removed when there were no signs of development.

Eggs were placed on sand in plastic bags with thermal sensing probes, and the bags were sealed with rubberbands and kept in closed styrofoam boxes. Bags were aerated, and moistened with water using a water sprayer once every week. Temperature was recorded twice daily throughout incubation, using a digital thermometer. Boxes were kept in two separate rooms under different temperature regimes. Eggs were candled once every week for the first 3 months, and then once every month. This helped to determine embryo position, development of blood vessels and embryo mortality. Embryo position and the development of blood vessels were marked with pencil on the egg shell. It was found that all live embryos responded as soon as the egg was moved close to the candling light. usually movement of the head, tail or feet was noticed. Embryo mortality was detected if the embryo did not respond to the light, and dead embryos were preserved immediately. A total of six clutches were incubated, using the above mentioned method.

The hatchlings were measured soon after hatching for total length, snout-vent length, weight, head width and head length. Individuals were marked by cutting 'V' shaped notches on the tail crest. This method worked well and had to be redone only once in two years. The animals were kept in glass tanks for 4 weeks for further observation and then released in a pen. Growth was monitored every month for the first 10 months, and then every 4 months. On all sampling periods, sexing by various methods were tried. Hemipenis extrusion, tailbase measurements and other observations on external features were made. Sexing by means of a probe was also tried. The flaps and pores close to the hemipenis region and tailbase measurements were compared in hatchlings, yearlings and adults.

Results

The first mating activities were observed soon after the wild caught, adult lizards had settled in their new pen. Within two consecutive years, 1987 and 1988, six clutches were laid (Table 1). Table 1 presents data on egg deposition times, number of clutches laid per female, and clutch sizes. One clutch, which went undetected in 1988, was discovered when two hatchlings were found in the breeding enclosure. A total of 8 eggs were found and since no other data could be obtained on these eggs, they are not included in the analysis.

The egg laying frequency of females 1 and 2 shows that two clutches might be laid within one year. This differs from the assumption of Bowers (1981) that eggs might be laid only every other year. The mean clutch size (omitting clutch two of female 1), is 13.8. Table 2 presents data on egg sizes.

That there is probably no strong correlation between egg and female size is demonstrated by female 1. Mean egg size in female 1 is significantly different in the three clutches, decreasing in size from clutch one to clutch three. Comparing clutch three of female 1 to the clutch of female 2, there appears to be a correlation between clutch size and egg size. The smallest clutch (N = 8) contained the largest (82.6 mm length) and heaviest (82 gm) eggs. Egg length of all clutches ranged from 67.2-82.6 (x = 73.49 +/- 0.417 SE) mm, egg width was between 32.3-43.3 (x = 39.44 +/- 0.267 SE) mm. Eggs weighed 33.0-82.0 (x = 61.96 +/- 1.2 SE) gm. Egg length was moderately correlated with egg weight (r = 0.556). Clutch size (N = 6) was negatively correlated to both egg length (r = - 0.559) and to egg weight (r = - 0.459). Egg length and weight were strongly and positively correlated (r = 0.902). Nevertheless, more data is needed to verify these findings.

Comparing the data given here to published egg sizes of water monitors, there is a significant difference only with information reported by Deraniyagala (1931), who mentioned much larger eggs, with a length of 92 - 100 mm, and a width of 35 - 38 mm, from Sri Lanka. Water monitor eggs found in the Phlippines are smaller on the average, than those reported here.

All eggs, including one clutch found scattered on the ground and the rest laid in nests, were artificially incubated. After eight days of incubation, it was easy to detect the embryo and blood

TABLE 1: Clutch sizes and laying dates of *varanus salvator* at the Madras Crocodile Bank

Female	Clutch numbers	Clutch sizes	Egg deposition date
1	3	15, 7, 17	14.5.87, 10.8.87, 20.9.88
2	3	8, 15, 14	29.5.87, 12,8.87, 1.10.88

TABLE 2: Egg sizes of *Varanus salvator* at the Madras Crocodile Bank.

Female (Clutch Number)	Egg Length (mm) Range (Mean + SE)	Width (mm Egg Range (Mean + SE)	Weight (gm) Range (Mean + SE)
1 (1, n = 15)	70.2-80.66 (76.18 ± 0.84)	32.5-41.55 (39.86 ± 0.59)	48.0-76.06 (67.4 ± 1.82)
1 (2, n = 7)	71.5-74.3 (73.214 ± 0.416)	36.5-40.5 (39.114 ± 0.596)	40.0 - 66.0 (59.86 ± 3.44)
1 (3, n = 17)	68.1-73.6 (70.720 ± 0.386)	32.3-41.95 (39.0 ± 0.636)	36.4 - 64.6 (57.4 ± 1.74)
2 (1, n = 8)	77.1-82.6 (79.26 ± 0.717)	39.7-42.9 (41.688 ± 0.394)	72.0 - 82.0 (77.5 ± 1.18)
2 (1, n = 15)	67.2-76.4 (72.01 ± 0.706)	35.0-41.3 (39.707 ± 0.429)	33.0 - 68.0 (61.4 ± 2.18)
2 (2, n = 14)	69.6-76.9 (972.98 + 0.605)	32.4-40.5 (38.06 + 0.654)	33.1 - 63.8 (54.46 + 2.88)

vessels by candling. Embryos were horseshoe shaped and blood vessels had a circular formation which later spread around the egg. The embryo position shifted downward from the top of the egg to the bottom on one side of the egg.

The first two clutches were incubated at temperatures ranging from 25° to 30 ° C, and hatchlings pipped after nine months. While increasing the incubation temperature to 31 - 32°, the hatchlings of the next two clutches pipped after eight months. A further increase in temperature to 32 - 33° C reduced the incubation period to seven months for the last clutches, indicating that incubation period is temperature dependent.

The time interval between the pipping of the first and last hatchlings of the same clutch ranged from two to four days. These observations differ markedly from the 241 to 327 days for one clutch reported by Kratzer (1973).

While some of the eggs collected were infertile, others stopped developing after some time, and in others the fully developed embryos were found dead. In total, 20 vigorous juveniles hatched from the six clutches; 16 of them are still alive. Representative growth rates of the three 1988 hatchlings are shown in Table 3.

While generally growing quickly, all (not only those represented in Fig.1) juveniles show a slowdown or cessation in growth during the cool winter months (November to early February). Afterwards the growth continued normally. The average total length after two years exceeds one meter, so the juveniles more than tripled in size within two years. It is assumed that sexual maturity will be reached within the next year, when they are three years old.

Sexing of live monitors, a serious problem with many species, will be briefly dealt with here, since more data is required to confirm our findings. All the various methods we tried to differentiate sexes were unsuccessful. The hemipenis was difficult to extrude manually or even by injecting water with a disposable syringe into the hemipenis region. The flaps and pores were the same for all animals and no differences were noticed. Sexing by means of a probe is a potentially erroneous method; the reasons will be dealt with in a later paper. For many varanids a considerable size difference between the sexes, and a quicker growth for males, has been reported (Mertens, 1942a; Auffenberg, 1981; Whitaker, 1982), which may be true for water montitors too. However, some of the sub-adult females were only slightly lighter in weight, and almost as long as the males from the same clutch. A series of measurements of about 180 living *V. s. marmoratus* in the Philippines also showed only a slight size difference between the sexes in adults, which

TABLE3: Growth records of three junvenile *Varanus salvator*, Hatched at the Madras Crocodile Bank in 1988.

Date	Total length (cm)			Snout-vent length (cm)			Weight (gm)		
	F	F	M	F	F	M	F	F	M
4/4/88*	28.6	29.6	32.0	13.0	13.2	13.9	35	50	48
20/6/88	49.2	50.7	54.2	20.0	21.5	23.5	185	170	245
24/7/88	59.3	60.8	64.2	24.0	24.5	27.0	220	330	265
24/8/88	64.7	68.4	73.0	25.7	26.5	28.6	260	405	465
26/9/88	65.6	69.2	75.4	26.0	27.0	31.0	265	440	500
25/10/88	66.4	70.6	77.0	27.5	28.0	31.0	275	450	500
25/11/88	66.8	71.1	78.8	27.5	28.0	32.3	270	450	520
23/12/88	67.0	71.4	79.7	27.5	28.5	32.8	340	580	720
26/1/89	68.1	73.9	83.5	28.2	28.8	34.5	380	600	810
26/2/89	71.2	74.8	87.9	28.7	31.4	35.0	410	710	1100
11/4/89	79.4	85.1	95.7	32.0	33.5	37.6	570	950	1200
12/9/89	85.5	99.0	102.0	34.0	38.0	42.0	700	1200	1150
14/4/90	97.9	106.5	115.6	40.2	42.8	46.4	1000	1770	2120

cannot be used for sexing. (Gaulke, 1989). Nevertheless, the two year old animals can be accurately sexed visually, since their hemipenial pockets are bulging, though not in the one year old animals.

Future Aspects

Some ecological data on water monitors, such as habitat and food preferences, was obtained by several workers, in the course of different field studies (Vogel, 1979; Luxmoore & Groombridge, 1989; Gaulke, 1989). Based on the data obtained, it is now possible to keep them under optimal conditions in captivity. The results achieved at the Madras Crocodile Bank during the initial phase of the water monitor breeding program show that they can be successfully bred in captivity. Nevertheless, some problems may arise, especially with regard to incubation, considering the very long incubation period. These problems can be overcome only by careful experiments using different incubation techniques with controlled temperature and humidity. Special attention should be paid to temperature - dependent sex determination which has not yet been looked at in monitor lizards.

Records of the next year will show whether biannual reproduction is an exception or occurs regularly. Growth rates, attainment of sexual maturity, as well as intraspecific behaviour within the enclosure will be thoroughly studied and recorded. The construction of a much larger enclosure for the research described is planned for the future. The success of this breeding program will hopefully lead to two future goals :

1. Captive-reared progeny can be supplied to zoos to cut down capture of free living animals, and for reintroduction to suitable habitats.

2. Water monitor farming as a future alternative to skin hunting in the wild, can be demonstrated, which will benefit the wild monitor populations as well as the local people.

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HERPETOLOGICAL INVESTIGATIONS IN THE WESTERN GHATS, SOUTH INDIA. PART I. THE VANJIKADAVU AND NADUKANI FORESTS, KERALA STATE

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ABSTRACT: Between February and March, 1990, herpetological fieldwork in the Vanjikadavu and Nadukani forests, in Trichur district, Kerala, India, was conducted. Twenty one species of amphibians and reptiles were observed during the said period, including representatives of anurans, caecilians, testudines, snakes and lizards. Data on microhabitat, parasites, and reproduction are also presented herein.

THE remarkably rich herpetofauna of the tropical moist forests of Kerala, in southwestern India, has been the subject of suprisingly few investigations, and basic biological data, needed for management and conservation, on species endemic to the Western Ghats, is still lacking.

We conducted field surveys in the Vanjikadavu and Nadukani forests of Chalakudy Division, Trichur district, Kerala, south India, between 26 February - 4 March and 20 - 26 March, 1990, as part of a larger project to collect status, distributional, taxonomic and ecological data on the amphibian and reptilian species of the Western Ghats.

There seems to have been no previous faunistic surveys of the Vanjikadavu region of Chalakudy subdivision. The area lies approximately 6 km west of the Kadar settlement of Anaipandam, and comprises primarily evergreen forests, punctuated with secondary forests, which bear scars of forest fires. Nadukani is situated approximately 8 km from Anaipandam, and comprises more intact evergreen forests. Both valleys are thought to support populations of the endemic Western Ghats testudines, *Indotestudo forstenii* and *Geoemyda silvatica*, the ecology of which was studied by the biologist J. Vijaya, in the Nadukani region, between 1983-84.

The following abbreviations have been used in the text: Snout-vent length (SV), total body length (TBL), head width(HW), straight carapace length (SCL) and straight carapace width (SCW). HW was taken at the angle of the jaws for amphibians, lizards and snakes, at the greatest width for the tortoises.

AMPHIBIA

Anura

1. *Bufo microtympanum* Boulenger (1882)

Material: Two examples, SV 3.45 and 2.53 cm, HW 1.25 and 0.9 cm. Vanjikadavu. 28 February 1990.

Ecological notes: Both examples were found at a forest clearing, near a stream, at night.

2. *Nyctibatrachus major* Boulenger (1882)

Material : One example, SV 1.73 cm, HW 0.77 cm. Vanjikadavu. 27 February, 1990.

Ecological notes: Found under a stone, along the side of a stream, on water-logged substrate.

3. *Rana beddomeii* (Gunther, 1875)

Material : Six examples, SV 2.24 - 3.23 (x = 2.64 +/- SD 0.39) cm, HW 0.87 - 1.3 (x = 1.03 +/ - SD 0.17) cm. Nadukani and Vanjikadavu.

Ecological notes : A very common species, especially at Nadukani, found on the dry stream bed, tree buttresses and on the forest floor, often

in association with *Rana keralensis*. When surprised under a rock, it expelled a jet of watery fluid.

4. *Rana brachytarsus* (Gunther, 1875)

Material : Five examples, SV 2.03 - 3.34 (x = 2.43 +/- SD 0.53) cm, HW 0.87 - 1.29 (X = 0.996 +/- SD 0.18) cm. Vanjikadavu. February, 1990.

Ecological notes : Found under stones in a semi-dried stream bed.

5. *Rana keralensis* Dubois (1980)

Material : Five example, SV 1.87 - 2.76 (x = 2.27 +/ SD 0.34) cm, HW 0.67 - 1.01 (x = 0.89 +/- SD 0.14) cm. Nadukani and Vanjikadavu.

Ecological notes : Appeared abundant in both localities, especially under rocks on the dry stream bed, where the substrate was moist. Some were found in typical gecko habitats such as rock clefts and tree buttresses, at night.

6. *Rana temporalis* Gunther (1864)

Material : One example, SV 1.18 cm, HW 0.41 cm. Nadukani. 2 March, 1990.

Ecological notes: The single example of this species was found under a rock on a dry stream bed. Frogs of other species *(Rana beddomeii and R. keralensis)* were also found in the same general microhabitat.

7. *Microhylid*

Material: One example, SV 3.27 cm, HW 0.87 cm. Vanjikadavu. 25 March, 1990.

Ecological notes: A frog which belongs to a hitherto undescribed species of microhylid, was found under stones, besides a hill stream during the day. It appears to be related to the *Ramanella - kaloula* group of microhylids.

GYMNOPHIONA

8. *Ichthyophis peninsularis* Taylor (1960)

Material : One example, TBL 23.5 cm, HL 1.76 cm, HW 0.97 cm, primary and secondary folds 365. Vanjikadavu. 28 February, 1990.

Ecological notes: Material was found under rocks,in moist substrate, comprising of sand and gravel, near a stream, with a depth of <10 cm, with some submerged aquatic vegetation. Also found in similar situations were frogs *(Rana keralensis,* and the aforementioned microhylid).

REPTILIA

Testudines

9. *Indotestudo forstenii* (Schlegel and Muller, 1840)

Ecological notes: Four tortoises were seen during two half day searches in Nadukani between 2-3 March, 1990. Two were seen under boulders, about 2 m deep. One, a female (SCL 20.7 cm, SCW 14.24 cm), was found at dusk on a dry boulder-strewn stream bed. A male, (SCL 21.0 cm, SCW 14.63 cm) was found buried under the leaf-litter, in the forest floor, in the early part of the morning. Two unidentified ticks were recovered from the shell and under the right hindlimb of the female, no ticks were to be seen on the shell or soft parts of the male. The tick *Amblyomma geoemydae* has been recorded from the species, taken from the "Chalakudy forests", presumably the same area, by Vijaya (1983).

SERPENTES

10. *Dendrelaphis bifrenalis* (Boulenger, 1890)

Material : One example, female, TBL 79.3 cm, TL 31.6 cm, HW 1.12 cm. Vanjikadavu. 1 March 1990.

Ecological notes: The specimen was found in a reed stand near a stream, during midday, while it was chasing a *Rana beddomeii.*

11. *Ptyas mucosus* (Linn., 1758)

Ecological notes: Ten adults seen and photographed at Vanjikadavu during the trip, including a copulating pair around midday, under shrubs, on a steep bank of a stream. One was seen sleeping on a fairly low branch of a tree besides a forest path, during the day.

12. *Amphiesma beddomei* (Gunther, 1863)

Material: One example, TBL 46.0 cm, SV 34.0 cm, HW 0.93 cm.

26 February, 1990. Vanjikadavu.

Ecological notes: Found under a boulder at dusk. Another example, a juvenile, TBL 42 cm, TL 10 cm, found in a dry stream bed on the night of 28 February, 1990, from the same locality has a yellow band along the nape.

13. *Ophiophagus hannah* (Cantor, 1836)

Ecolongical notes: An adult male, TBL 310

cm, TL 54 cm, was photographed on 28 Febrauary, 1990 on a steep outcrop, overlooking a waterhole, during late afternoon, at Vanjikadavu. Another slightly larger specimen was discovered dead in a deep natural pit by Kadar tribals at the top of large waterfall at Kundurmadu.

14. *Hypnale hypnale* (Merrem, 1820)

Material : One example, female, TBL 29.5 cm, HW 1.37 cm. Nadukani.

Ecological notes: The example was found on a low branch of a shrub, 5 cm above the forest floor, during early parts of the morning. The stomach was found to be empty. Another example was found at dusk on a rock, on a dry stream bed.

SAURIA

15. *Psammophilus blanfordanus* (stoliczka, 1871)

Material: One example, male, TBL 20.5 cm (tail-tip missing), SV 9.5 cm, HW 2.19 cm. Vanjikadavu. 4 March, 1990.

Ecological notes : The specimen was observed on a boulder during midday. The head and anterior part of the body were bright crimson, the rest intense black. Left forelimb damaged, with missing digits. Another male of this species was seen in a similar microhabitat, also with a damaged tail. Agressive male-male encounters during the breeding season may account for the physical injuries seen on the bodies of this rock lizard.

16. *Calotes rouxii* Dumeril & Bibron (1837)

Material: Seven examples, TBL 18.5 - 22.8 (x = 21.186 +/- SD 1.695) cm. SV 5.3 - 6.9 (x = 6.157+/- SD 0.565) cm, HW 0.96 - 1.55 cm (x = 1.28 +/- SD 0.216) cm. Nadukani and Vanjikadavu. 28 February, 2, 3 & 4 March, 1990.

Ecological notes : Specimens were seen on the bases of trees, on boulders near streams and in cracks on fallen tree trunks, throughout the day. Reddish-coloured mites were observed between the scales of some of these lizards.

17. *Draco dussumieri* Dumeril & Bibron (1837)

Material : One example, adult male, TBL 15.0 cm + (tail tip missing), SV 8.25 cm, HW 1.25 cm. Vanjikadavu. 23 March, 1990.

Ecological notes: Observed on a tree trunk, during the day, near a forest clearing.

18. *Mabuya beddomei* (Jerdon, 1870)

Material : Five examples, TBL 12.2 - 15.0 (x = 13.08 +/- SD 1.108) cm, SV 5.12 - 6.1 (x = 5.516 +/- SD 0.473) cm, HW 0.85 - 1.05 (x = 0.93 +/- SD 0.094) cm. Nadukani and Vanjikadavu. 27 February and 2 March, 1990.

Ecological notes: Examples of the species seen in forest undergrowth and sides of forest paths during the day.

19. *Leiolopisma travancoricum* (Beddome, 1870)

Material: Two examples, TBL 10.0 and 13.5 cm, SV 3.62 and 5.82 cm, HW 0.63 and 0.93 cm. Vanjikadavu. 1 and 20 March, 1990.

Ecological notes: Observed in a forested patch near stones, during the day. These brightly-coloured day-active lizards were plentiful around rocks near water-bodies during the day.

20. *Cnemaspis indicus* (Gray, 1846)

Material: One example, hatchling, TBL 3.5 cm, SV 1.67 cm, HW 0.33 cm. Nadukani. For dates, see below.

Ecological notes: A hatchling emerged on 10 March, 1990, from an egg, 0.77x 0.69 cm, found under a tree buttress, half-buried in loose soil, on 2 March, 1990. Whereas it matches the description of *Cnemaspis indicus* in Smith (1935), the present example had the following characteristics (colour nomenclature and codes [#] follow Smith (1975) :

Crown warm sepia (#221A), a thin chamois (#123D) line running from the nostrils, over the eyes and meeting at the nape, where they converge and broaden, becoming darker (cinnamon, # 123A) and extend over the body to the tail-tip. Sides of head and body (dark) sepia (#119), limbs (light) sepia (#219), digits banded with cinnamon (#123A). Undersurface glaucous (#80), with lighter blotches.

21. *Cnemaspis kandiana* (kelaart, 1852)

Material : Four examples, TBL 3.0-4.5 (x = 3.87 cm; one damaged), SV 1.52-3.1 (x = 2.26)

cm, HW 0.3-0.5 (x = 0.4) cm. Nadukani. 3 March 1990.

Ecological notes: All examples were seen on tree trunks and buttresses, about a metre from the ground. The largest specimen seen was SV 3.1 cm and had two large yolked ovea. One of the four examples had a light vertebral stripe.

General Remarks

Studies on the herpetofauna of Western Ghats continue to add new species to science (see for instance Inger *et al.*, 1984, 1984a; Pillai, 1978, 1979, 1981, 1986; Pillai and Pattabiraman, 1981; Whitaker and Dattatri, 1982). Because the region consists not of a contiguous forested area, but of valleys and ridges that are isolated from each other, a significant proportion of the herpetofauna may be endemic to the region. It is suggested that more long term studies be conducted in the area, preferably at different seasons. The list given above is clearly not exhaustive, and several other species of reptiles and amphibans were seen/ heard, such as the Malabar gliding frog, *Rhacophorus malabaricus*, which was heard calling every night.

During these investigations, evidence of forest fires were seen, many of which were apparently started accidentally by the Kadar tribals themselves. The impact of this to the herpetofauna, the mammal life as well as to tree-nesting bird species, such as the great pied hornbill *(Buceros bicornis)*, which was seen nesting in Vanjikadavu during the survey is obvious. A herpetological sanctuary, the 'first' for Asia, could be a way to save this relict evergreen forest and its rich herpetofauna.

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PRELIMINARY OBSERVATIONS ON THE NESTING OF THE OLIVE RIDLEY SEA TURTLE (LEPIDOCHELYS OLIVACEA) ON THE MADRAS COAST, SOUTH INDIA

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ABSTRACT: As part of a long-term programme to protect the nesting populations of the olive ridley sea turtle *(Lepidochelys olivacea)* and their nesting grounds along the east coast of India, a hatchery was established near Madras in the winter of 1988-1989. Nests were collected and brought to a hatchery to be incubated in near natural conditions, and the hatchlings released upon emergence. 8,625 eggs, representing 69 clutches, were collected and 5,725 living hatchlings obtained, indicating a hatchling success of 63.38%. Mean clutch size was 126.83 and incubation period ranged from 49-52 days. During the 1988-1989 season, nesting peaked towards the end of January.

THE olive ridley sea turtle *(Lepidochelys olivacea)* is the commonest species of sea turtle nesting on the east coast of India. In Tamil Nadu, this species is referred to as *sith aamai* or *kadal aamai*. The biology of the species in the region has been studied by Valliappan and Whitaker (1974), Biswas (1984), Silas (1984), Biswas *et al.* (1977), among others. Nevertheless, data on reproductive biology and other key facets of its natural history is scant.

A conservation programme was started in 1989 at Madras, Tamil Nadu, by the Students Sea Turtle Conservation Network (SSTCN), to protect the nesting populations of the olive ridley and the nesting grounds along the east coast of India. The area selected was a 30 km stretch from the Adyar estuary to the Madras Crocodile Bank Trust (13° N, 80° E). The site selected for the sea turtle hatchery was Neelangarai, adjacent to the Tamil Nadu Fisheries Department Prawn Hatchery, approximately 20 km south of Madras City. It was chosen for its accessibility to the city and availability of basic amenities. An account of the programme is given by Abraham (1989).

NEST COLLECTION

The Madras coastline is sandy with few or no rocks. Dominant vegetation includes *Ipomoea, Pandanus* and *Spinifex*, and part of the coastline is backed by *Casuarina*, an exotic species, introduced for fuel wood and as a wind-break. There is one fishing village every 1.3 km and an expanding urban population.

The survey area was patrolled on foot every night between December 15, 1988 and February 28, 1989. Nests were located from the tracks of turtles without the use of probes. Eggs were transferred to the hatchery in soft cloth bags and attempts were made to minimize stress and jolting during transport. Nests were relocated within 3-4 hours of laying in pits 46 cm deep. Each nest was numbered and kept under observation throughout the incubation period. On appearance of a cup-shaped depression on the sand over the nest, a wicker basket was placed over it. Nests were allowed to remain undisturbed for a period of 24 hours after the emergence of the first hatchling. On excavation the remaining hatchlings were collected and released, at a distance of 6 m from the water line.

The hatchery was constructed at a height of 30-35 m from the high tide line and was 9.09 x 4.54 m in size. Wooden fence posts, and galvanised chainlink fencing with a mesh diametre of 5 cm were used for the enclosure. The fence was buried 0.3 m into the ground to keep out excavating predators. The height of the enclosure was 1.21 m.

Reproductive Biology

The nesting season of the olive ridley on the Madras coast starts with the advent of the north-east monsoons in November and continues till March. Nesting season of the species appears to vary between climatic zones. In the Indian Ocean region, nesting has been reported between September and January in Sri Lanka (Deraniyagala, 1939), between January and April on the east coast (Biswas, 1982) and late October to April for the Madras coast (Silas, 1984).

Nesting on the Madras coast during the 1988-89 season began in late December, and continued till the end of March, with a peak in the last third of January, following which nesting activities declined abruptly. There were two minor peaks which were noticed during the month of February.

Female ridleys emerged between 2000 hours (2 hours after sunset) and 500 hours, and did not appear affected by tides, presumably because the difference between the heights of the high and low tides in the study area is negligible. We estimate nesting density in the area to be less than 15-20 nests/km/season.

Nests (N = 5) were 5.5 - 15.0 (x=9.37 +/- 2.1 SE) m from the water line. Depth of six nests (to first and last eggs, respectively) were 18 - 41 (x = 29.0 +/- d.86 SE) cm and 38 - 56 (x = 45.83 +/ - 3.05 SE) cm. Data on nests have been presented in Table 2. A few clutches contained one or two small, underdeveloped and yolkless eggs. A clutch of 155 eggs had two double-yolked eggs that failed to hatch, and no embryos could be detected. Incubation period, including emergence time progressively declined from 52 to 49 days, and appears to be determined by the ambient temperature, since the temperature increases at the end of the nesting season.

Three lightly pigmented hatchlings were obtained from the same clutch, which took longer to emerge than their normalcoloured siblings. However, these failed to survive.

Sixty eight clutches, comprising 8,625 eggs, were collected between 12 January and 19 February, 1989. Clutch size ranged from 88-155 (x = 126.84 +/- 2.12 SE). Silas and Rajagopalan (1984) report a clutch size 79-166, mean 126 (N = 23) and (Valliappan and Whitaker, 1974) record clutches of 94-140, mean 114.7 (N = 10). Total number of hatchling obtained was 5,725, indicating an overall hatching success of 63.38 % (range 6.4 - 99.11).

TABLE I: Summary of results of hatchery operations.

Number of clutches	68
Total number of eggs	8,625
Total number of hatchlings released	5,725
Mean clutch size	125.83
Incubation period (days)	49-52
Overall hatching success (%)	66.38
Dead inpipped eggs (%)	22.25
Dead in nest (%)	1.59
Unhatches (%)	9.59

General Observations

On the Madras coast, exploitation of sea turtles is restricted to egg collection, the adults are generally not killed. In the virtual absence of enforcement, sea turtle eggs collected are sold for consumption at regular fish markets and to the local inhabitants at the rate of Rs.15-20 (U.S. $ 1 = Rs.17) per hundred. Interestingly, the traditional fishing communities do not eat sea turtle eggs.

The most important of non-human predators of the Madras coast include crabs *(Ocypode* sp.) and jackals *(Canis aureus)*. Other predators include the mongoose (*Herpestes* sp.) gulls (*Larus* sp.), common and jungle crows (*Corvus splendens* and *C. macrorhynchos*). No quantitative data is available on predation on the ridley nests on the Madras coast.

A major threat is the use of gill and trawl nets. During the 1988-1989 season, 10-12 olive ridley carcasses were seen on the coast in the study area, which were presumed to have drowned in fishing nets.

The other cause for concern is the encroaching urban population which could be detrimental to the sea turtle nesting habitats and the coastal environment in general. Tourism, pollution and sand mining activities are increasingly evident on the Madras coast, and beach lighting is on the increase; the deleterious effect of these developments on hatchlings and nesting sea turtle populations is well known.

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DISTRIBUTION AND CONSERVATION PROBLEMS OF THE HIMALAYAN NEWT (TYLOTORITON VERRUCOSUS) IN THE DARJEELING HIMALAYAS

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ABSTRACT: *Tylototriton verrucosus* the Himalayan newt or Indian salamander, has been identified as endangered in India. The species occurs in lentic habitats in the eastern Himalayas of Darjeeling, and elsewhere further east and west. This paper reviews its biology and outlines conservation problems and measures to protect this threatened species.

THE Himalayan newt or Indian salamander *(Tylototriton verrucosus)* is the sole representative of the order Caudata in the Indian Subcontinent, distributed from Nepal eastwards through the Eastern Himalayas to south-east Asia. the biology of Indian populations has been studied by Annandale (1907, 1908), Chaudhuri (1966), Das (1987), Dasgupta (1983, 1984, 1988) and Smith (1924). I have conducted investigations on this species in the Darjeeling Himalayas for the past several years, and report here on its distribution and conservation.

Two varieties occur at Nam Thing, a light brown variety and a dark chocolate brown variety. At Pacheng (in November), both males and females have a dark chocolate brown colour, which matches the background of the soil in the area.

In aquaria, eggs are laid on aquatic weeds and attached singly. Females are known to guard egg clutches, while hidden amidst stones. In the wild, eggs may also be laid at the bottom of puddles and ditches, or lightly attached to blades of grass.

At Pacheng and Sonada, the species often shelters among bamboo stumps, and feeds on termites, wood-lice and corprophilous insects infesting the rotting bamboo stumps (J. Halder *pers.comm.).* The species appears to have a broad, unspecialised diet. During the monsoons, it is known to feed on algae, water beetles and bugs, as well as tadpoles of the tree frog, *Polypedates leucomystax*, at Nam Thing. After a heavy shower, adults come on land to feed on insect larvae, snails, slugs and earthworms. At Pacheng, these animals were also found to shelter amidst stacks of fire-wood kept in the courtyard of houses, in the month of November.

DISTRIBUTION

Tylototriton verrucosus occurs at altitudes between 4,000 - 6,000 (1200 - 1800 m.) feet in Darjeeling, according to Smith (1924). Chaudhuri (1966) mentioned that the species is found between 5,000 - 7,400 (1500 - 2250 m.) feet, occuring in the Toomsung Tea Estate and the Sukhiapokhri, Sonada and Tung regions of the Darjeeling Himalayas. Dasgupta (1988) reported the species from Mirik Lake, the Raidhap region above the Lake, and at Nakha Pani, at Gopal Dhara Tea Estate. Of the areas surveyed till date, the species has been found in the following ponds and lakes:

1. Nam Thing, at Sitong, near Shelpu.

Area : 20 acres, *Depth* : 4 m, *Other physical features* : Ovoid outline, basin hard, clear water, adjoining area used for grazing.

2. Bagora, at Bagora.

Area : 3 - 5 acres, *Depth* : 2-3 m, *Other physical features:*

Rectangular outline, basin soft, effluents from

settlements discharged into the water.

3. Jorepokhri, above Sukhiapokhri.

Area : 3 acres, *Depth*: 4m, *Other physical features:* Circular outline, one of two water bodies, the other was land-filled for agriculture. Area gazetted a Sanctuary, but is used for cattle grazing.

4. Nakha Pani, at Gopal Dhara Tea Estate.

Area: 1.5 acres, *Depth*: 2-3 m, *Other physical features:* Roughly triangular in outline. Water with a film of oil. Being drained for agriculture.

5. Sanu Simana, between Gopal Dhara and Pashupati.

Area: 1/2 acre, *Depth* : 6 m, *Other physical features*: A dry lake bed, where pools and puddles form during the monsoons.

6. Mirik Lake, at Mirik

Area : 10 acres or more, *Depth* : 6 m, *Other physical features:* Once a natural lake, now enlarged for boating and angling.

7. Raidhap, above Mirik Lake

Area : 7 acres, *Depth* : 3 m, *Other physical features* : Swamp which drains into a stream, where fish have been introduced.

8. Pachend, at Pacheng Tea Estate, Near Sonada.

Area: 2 - 3 acres, *Depth*: 3 m, *Other physical features* : Artificial reservoir, used for water supply and power generation. Completely dry during dry season.

9. "Lake" at Margaret Hope Tea Estate, near Sonada.

Area : 3 acres, *Depth* : 2 m, *Other physical features* : Once a natural lake, the bed now has an artificial reservoir.

10. Sukhiapokhri.

No water at present. Human habitations have been estabilished over the now dry lake bed.

This list is not exhaustive, as many more apparently suitable lentic habitats occur in the area, and the presence of *Tylotoriton verrucosus* seems to be an indicator of undisturbed standing water bodies. Areas within the Darjeeling Himalayas where the species has been reported include Ghoom, Pokhriabong and Manbhanjang.

Conservation

Tylotoriton verrucosus is the only member of a widespread genus represented in the fauna of India and is recognised as endangered, being listed in Schedule I of the Indian Wildlife (Protection) Act of 1972. No data on populations exists, and observations indicate that the species is threatened in the eastern Himalayas, because of rapid modification of its lentic habitat, which is being drained for supply of water, housing and for agriculture. The effect of organochlorine pesticides on these amphibians is unknown and is suspected to be deterimental. Grazing by cattle is perhaps another serious factor, since soil loosened by hooves causes pond siltation, thereby decreasing the volume of water.

Artificial ponds constructed in parks could help in conversation of the species, as well as other small verterbrates (Dasgupta, 1987). Unfortunately, most such ponds in the Darjeeling area have steep vertical walls, which serve as deadly traps for small animals when water levels are low.

Other possible threats to the continue survival of the species is the introduction of carps and other freshwater fishes, since these may be potential predators of amphibians, including newt eggs (Dasgupta, 1988) and the capture of these animals for export. A single newt in the Sonanda area fetches a sum of fifty paise (= U.S. $ 0.03), and the staff of a nearby college buy newts from the local people, for sale to animal dealers at an unspecified price for supply to various educational institutions, both within and outside the country. Of late, there has also been considerable deforestation in the region, following implementation of various developmental projects, such as the construction of a motorable road in the Mirik region. During thunderstorms, newts reportedly crawl onto the road and get killed by traffic.

The fact that lentic habitats in the Darjeeling-Sikkim Himalayas are gradually becoming dry is inescapable. Efforts need to be made to protect areas that remain little-affected by anthropogenic pressures, such as Nam-Thing. A preliminary

study of various autotrophs in and around Nam-Thing, and a few other standing-water bodies in the area has been undertaken (Bera *et al*, 1989) to help plan for the conservation of the largely endemic flora and fauna of the Eastern Himalayas. More specific steps for protecting lentic habitats in the region, as outlined by Dasgupta *et al.* (1989) include stopping human habitations rock-blasting and quarrying activities in the vicinity of these habitats. Water bodies recognised as being habitats for newts and/or other threatened species need to be protected by suitable legislation from human utilization, such as draining for agricultural activities or supply to villages and urban centres. Deforestation of the watershed area should also be actively prevented, for this accounts for the siltation of newt habitats and reducing precipitation, in addition to causing land-slides. Certain forested areas that are known to support newt populations need to be specifically protected as sancturies. Finally, a captive-propagation programme for the Himalayan newt is suggested.

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A NEW FROG OF THE GENUS RANA *(RANIDAE: ANURA)* FROM MANIPUR, NORTHEASTERN INDIA

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THE anuran amphibian fauna of northeastern India has been the subject of a recent review, and several new species have been identified (Chanda, 1986). While studying a collection of amphibians made from the state of Manipur, in northeastern India, an undescribed species of frog was found which is being described here as :

Rana ghoshi sp. nov. (Fig. 1)

DIAGNOSIS : A large (60 mm snout-vent length) ranid, distinguished from other closely related species in having nostrils nearer to eyes than to tip of snout; tympanum one and a half times interorbital distance; second finger longer than first and heels meeting when hindlimbs are folded at right angles to body.

DESCRIPTION: Head depressed, broader than long; snout rounded, slightly projecting beyond lower jaw; canthus rostralis concave; nostrils much nearer eyes than to tip of snout; internarial space about one and half time interobital distance: tympanum half the diameter of eyes, seperated from the latter by a gap about half the tympanic diameter; tongue large; lower jaw with two tooth-like bony processes that fit in grooves on the upper jaw; vomerine teeth oblique, much nearer each other than to choanae.

Forelimbs moderately long, stout; fingers free (Fig. 1 c), with rounded tips; first finger slightly longer than second; third finger longest, slightly shorter than snout; subarticular tubercles very small but prominent.

Hindlimbs short; tibio-tarsal articulation reaching tympanum; heels just meeting when hindlimbs are folded at right angles to body; tibia twice as long as broad; more than one-third snout-vent length; toes with rounded tips, fully webbed (Fig. 1 B); subarticular tubercles small but prominent; inner metatarsal tubercle oval, prominent, nearly half the length of inner toe; outer metatarsaltubercle absent; a faint tarsal fold present; outer metatarsals separated at the base.

Skin of dorsum rough with small tubercles, ventral surface almost smooth. A glandular dorsolateral fold extends from eyes to posterior region of the body, ending near the groin.

Colour in alcohol, dorsally light, brown, with dark irregular blotches. A dark stripe extends from posterior of eyes to the shoulder. Ventrally pale.

MATERIAL : Adult female (Holotype, ZSI/KZ 318), Khugairk Reserve Forest, Manipur, India (alt. *ca.* 925 m). Coll. A.k.Ghosh. 18 January, 1975.

ETYMOLOGY : The species is named after Dr. Ashish Ghosh, who led the team to the survey area.

COMPARISONS : The horizontal pupil; presence of vomerine teeth; absence of parotid gland and omsternum and sterum with a bony style indicates that the present material is a member of the cosmopolitan genus *Rana*. I compare the new species with other ranids that are similar, according to the key to the species with other ranids that are similar, according to the key to the species of the genus *Rana* occuring in south and southeast Asia and Australia provided by Boulenger (1920).

Rana ghoshi sp. nov. appears to be closely allied to *Rana cyanophlyctis* Schneider (1799), differing in having nostrils nearer eyes than to tip of snout; tympanum about half diameter of eyes

Fig. 1 Holotype of Rana Ghoshi sp. nov.

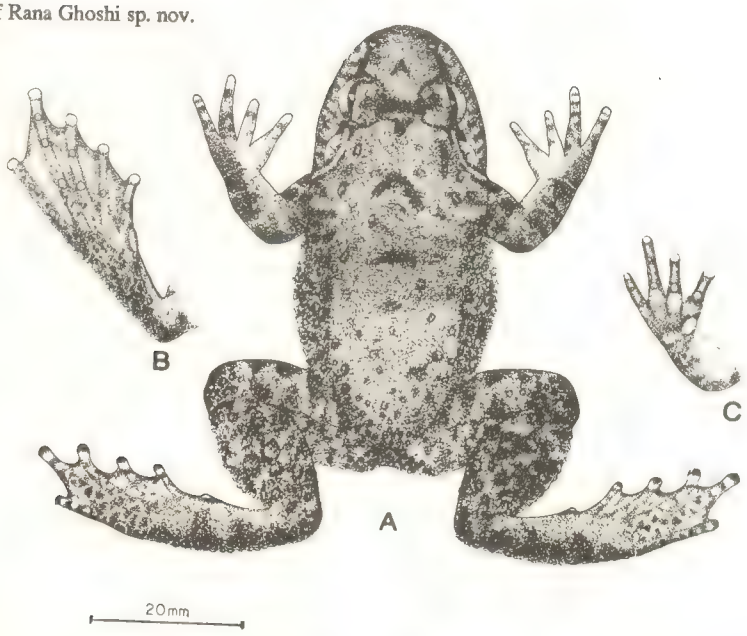

TABLE I: Measurements (in mm) of holotype of *Rana ghoshi* sp. nov. (ZSI/KZ 318).

Snout-vent length	60.0
Head length	19.5
Head width	22.0
Snout length	9.0
Eye diameter	8.0
Interorbital distance	4.0
Tympanum diameter	4.0
Forelimb length	12.0
Length of first finger	8.0
Length of second finger	7.5
Length of third finger	8.0
Hindlimb length	76.0
Length of third toe	14.5
Length of fourth toe	21.5
Length of fifth toe	19.0

and first finger longer than second (Boulenger, 1920: Minton, 1966). Another south Asian ranid, *Rana corrugata* Peters (1863) from Sri Lanka, appears to be closely related to the new species, but the hidden tympanum, shorter hindlimbs, a narrow fold along the innerside of the first toe and the tarsus in *R.corrugata* (see Kirtisinghe, 1957), features absent in *R.ghoshi* sp. nov., help to distinguish the two. The new species is similar to *Rana sternosignata* Murray (1885) from Afghanistan, Pakistan and Jammu and Kashmir, in northwestern India, but in this species, the first finger is shorter than the second and the hindlimbs are shorter, the heels not meeting when the hindlimbs are folded at right angles to the body, there are no tubercles and the tympanum is less than diameter of eyes (Boulenger, 1920; Minton, 1966).

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ON A COLLECTION OF REPTILES FROM BASTAR DISTRICT, MADHYA PRADESH, CENTRAL INDIA.

By

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Abstract: The paper deals with the reptiles collected by the Zoological Survey of India from Bastar district, Madhya Pradesh, central India, comprising 356 examples belonging to six families, 12 genera and 19 species.

Bastar district is situated in the southeastern corner of Madhya Pradesh, in central India. The district is surrounded by three other states. On the eastern side is Orissa; Andhra Pradesh in the south and Maharashtra to the west. North to south, the district is about 300km, its width about 200 km from east to west. This is the largest district of Madhya Pradesh, with an area of about 39,060 sq km. and is situated between latitudes 17° 46" N. and 20° .34" N. and longitudes 80° 15" E. and 82° 1" E.

The land is generally undulating, rocky and infertile. The district can be divided into five main physiogeographic divisions: Kotri-Mahanadi plain in the north Abujhmar Hills, northeastern plateau (Indravati plain), southern plateau which include Bailadila Hills, Tikanpalli hills and Dantewara plain, and Godavari- Sabari lowland.

The reptile fauna of this sparsely populated tribal district is unknown and no specific information on this fauna can be found in the literature. A survey of Bastar district was conducted by the Herpetology Division of the Zoological Survey of India between 1979 and 1981 and 356 specimens collected.

Systematic Account

Class : REPTILIA
Order : SQUAMATA
Suborder : SAURIA

Family: Gekkonidae

1. *Hemydactylus brookii* Gray (Brook's gecko)

Material examined : 7 ex., Reg. No. 23871-24171; 1 ex. Dantwara, 27 .II. 79; 6 ex., Sukna 1 - 2. III.79 (Collected by R.C. Sharma & D. P. Sanyal).

Measurements : Snout to vent 55 to 58 mm, tail 76 mm.

Distribution : Throughout the Indian subcontinent and in Pegu, Burma.

2. *Hemidactylus maculatus* Dum & Bibr. (Rock Gecko)

Material examined : 1 ex., Reg. No. 24155, Sukna, 28.II.79 (Collected by R.C. Sharma and D.P. Sanyal).

Measurements: Snout to vent 84 mm; tail 112 mm.

Distribution : Parts of south India, Bombay and Malabar.

3. *Hemidactylus flaviviridis* Ruppel. (Yellow bellied house gecko)

Material examined : 1 ex., Reg. No. 24158, Jagdalpur, 19.II.79 (Collected by R.C. Sharma and D.P. Sanyal).

Measurements: Snout to vent 87 mm; tail 86 mm.

Distribution: Northern India, Pakistan, Iran and the Arabian peninsula.

4. *Hemidactylus subtriedrus* Jerdon.

Material examined : 1 ex., Kutamawa,

24.I.1979 (collected by Dr.N.Mazumder).

Measurements : Snout to vent 92 mm; tail damaged.

Distribution : Tamil Nadu and Andhra Pradesh (Nellore and Ellore).

5. *Hemidactylus giganteus* Stoliczka

Material examined: 18 ex., Reg. Nos. 24730-24737; 10 ex., Konta 6-7. III 1979, 5 ex., Karker 5-8 III.79, 2 ex. Jagdalpur, 17.II.1979, 1 ex., Charma, 5.III.1979 (Collected by Dr. R.C. Sharma & D.P. Sanyal).

Measurements : Snout to vent 60 to 100 mm; tail 90 to 100 mm.

Distribution : Hyderabad, Godavari, Malabar and Palkonda Hill.

FAMILY - AGAMIDAE

6. *Calotes versicolor* (Daudin) (Garden lizard)

Material examined : 49 ex., Reg. No. 23771-24735; 6 ex., Konta, 21 to 24.II.79, 3 ex., Kondagaon, 7.III.79, 1 ex., Dantwara, 27.II.79, 10 ex., Kanker, 6 to 8.III.79 (Collected by Dr.R.C.Sharma & Party), 8 ex., Barsur, 31 to 2VI.1980, 6 ex., Pali, I.VI8. 80, 6 ex., Geedam, 4 to 6.VI 80, 2 ex., Chritapalli (D.P.Sanyal & party), 2 ex., Jagdalpur area, 12 to 14. IX. 81 (Collected by R.C. Sharma & D.P. Sanyal).

Measurements : Snout to vent 70 to 90 mm; tail 160 to 190 mm.

Distribution : Throughout India.

7. *Psammophilus blanfordanus* (Stoliczka) (Rock lizard)

Material examined: 180 ex., Reg. Nos. 23770-24567; 9 ex., Konta, 22 to 24.II.79,21 2x. Kondagaon, 7.II.79,38 ex., Sukna, 28.II.79 to 1.3.79, 17 ex., Charma, 5. III . 79, 9 ex., Duranpal, 23.II,79, 10 ex., Dantwara, 27.II.79, 20 ex., Kanker, 6.II.79, 1 ex. Chitrakut, 18. II. 79 (Collected by Dr.R.C.Sharma & Party), 1 ex., Chotadanga, 14.II.79, 1 ex., Pengunda, 30.I.79 (Collected Dr. N. Mazumdar), 7 ex., Barsur, 31.V.80, 4 ex., Pali, I, VI.80,3 ex., Geedam, I. VI.80, 4 ex., ca 5km. E. of Bijapur, 8. VI.80, 7 ex., Bailadia 4.VI.80, 9 ex., Bairamgarh, 2.VI.80, 7 ex., Chiritpall, 10.VI.80., ca 5 km. N.W. of P.W.D.I.B. Barsur, 2.VI.80 (Collected by D.P. Sanyal & Party), 2 ex., ca. 4 km. S.E. of Kondagaon 20.9.81., Kotapad 17.9.81, 1 ex.

Measurements : Snout to vent 107 to 110 mm; tail 130 to 160 mm.

Distribution : Bihar and Orissa, Madhya Pradesh, Eastern Ghatts,

8. *Sitana ponticeriana* Cuvier. (Fan throated lizard)

Material examined : 79 ex., Reg. Nos. 23772-24470; 1 ex., Kondagaon; 7.II.79, 5 ex. Korras 2.II.79, 1 ex., Duranpal. 23.II.79, 1 ex., Dantwara, 27.II.79, 4 ex., Karker 6.II.79, 12 ex., Konta, 22 to 24.II.79, 4 ex., Sukna. I.III.79, (Collected by Dr.R.C. Sharma & D.P.Sanyal), 1 ex., Pali, I.VI.80, 8 ex., Arupalli, 2.VI.80, 11 ex., Chiritpalli, 10. VI.80, 1 ex., Geedam, 5. VI. 80, 13.ex., Bhairamgarh, I. VI. 80, 9 ex., Barsur. (Collected by D.P. Sanyal & Party).

Measurements : Snout to vent 35 to 55 mm; tail 85 to 125 mm.

Distribution : Throughout India upto the foothills of Himalayas except West Bengal.

FAMILY: SCINCIDAE

9. *Mabuya carinata* (Schneider).

Material examined : 30 ex., Reg. Nos. 23872-24378; 1 ex., Dantwara, 27. II. 79, 3 ex., Kankar, 6 to 8. III. 79, 2 ex., Sukna, 28. II. 79, 2 ex., Charma, 5. III. 79, 9 ex., (Collected by Dr. R.C. Sharma) Boderpur, 15. VI. 80, 5 ex., Banpur, 14. VI 80, 2 ex., Ca 5 km. E. of Jagdalpur, 13. VI.80, 5 ex., Bailadila 4. VI. 80, 1 ex., Chiratapalli, 10. VI.80, (Collected by D.P. Sanyal & Party).

Measurements : Snout to vent 60 to 110 mm; tail 114 to 155mm.

Dsitribution : Indian peninsula.

10. *Mabuya macularia* (Blyth). (Little skink)

Material examined : 6 ex., Reg. Nos. 24204-24722; 1 ex., Banderpur, 15. VI. 80, 1 ex., Banpur 14. VI. 80 2 ex., Suklapara, 6. VI. 80, 1 ex., Balaidila 4. VI.80, 1 ex., Barsur, 31. V. 80. (Collected by D.P. Sanyal & Party).

Measurements : Snout to vent 60 - 90 mm.

Distribution : Northwestern India.

11. *Mabuya dissimilis* (Hallowell).

Material examined : 4 ex., Reg. Nos. 24209; 4 ex., Sukla para, 6. VI. 80, (Collected by D.P. Sanyal).

Measurements : Snout to vent 76 mm; tail 100 mm.

Distribution : Northern India.

FAMILY: LACERTIDAE

12. *Cabrita jerdoni* Beddome.

Material examined : 2 ex, Reg. No.24149. Sukna, I. III. 79 (Collected by Dr. R.C. Sharma & D.P. Sanyal).

Measurements : Snout to vent 33 mm; tail 60 mm.

Distribution : Northern and Central India.

13. *Cabrita leschenaulti* (Milne-Edward).

Material examined : 2 ex., Reg. Nos. 24150-24721; 1 ex., Sukna, I. II. 79 (collected by Dr. R.C Sharma & D.P. Sanyal), 1 ex, Bansur, 31. V. 80, (Collected by D.P.Sanyal).

Measurements : Snout to vent 34 mm; tail 70 mm.

Distribution : Bihar, Orissa (Ganjam), Palkonda Hills, S.E. Berar, Gadamari district, Nilgiri & Chitteri Hills, Salem district, Travancore, Sivagiri Hills.

SUBORDER: SERPENTES

FAMILY: COLUBRIDAE

14. *Amphiesma stolata* (Linnaeus) (Buff striped keelback)

Material examined : 4 ex., Reg. Nos. 23783-24376; 1 ex., Konta, 24. II. 79 (Collected by Dr. R.C. Sharma & D.P. Sanyal); 2 ex., Chiritapalli, 10.VI.80, 1 ex., Ca 2 km. S.W. of Jagadapur area, (Collected by D.P. Sanyal).

Measurement : Snout to vent 212 mm; tail 65 mm.

Distribution : Through out the Indian subcontinent.

15. *Lycodon aulicus* (linnaeus).(common wolf snake)

Material examined : 2 ex., Reg. Nos. 23974-24280; 1 ex.,Pali, I.VI.80, 1 ex., East of Gidam, 6 VI. 80, Damaged (Collected by D.P. Sanyal).

Measurements ; Snout tovent 37 mm; tail 8 mm.

Distribution : Throughout India from the base of the Himayalas to the south. Also Nepal, Bangladesh, Sri Lanka, Burma and south China.

16. *Ptyas mucosus* (Linnaeus). (Rat snake)

Material examined : 1 ex., Reg. No. 23856; Duranpal, 28. II. 79, (Collected by Dr. R.C. Sharma & D.P. Sanyal).

Measurement : Snout to vent 660 mm; tail 331 mm.

Distribution : Southwest, south and southeast Asia, including the entire Indian subcontinent.

17. *Xenochrophis piscator* (Schneider). (Checkered keelback)

Material examined: 2 ex., Reg. Nos. 23855-24568; 1 ex, Duranpal, 23. II. 79, (Collected by Dr. R.C. Sharma & D.P. Sanyal), 1 ex., Stn. 3 ca % km. N.W. of P.W.D.I. & Barsur, 2. VI. 80.

Measurement : Snout to vent 150 mm., tail 40 mm.

Distribution : Throughout the Indian subcontinent.

18. *Elaphe radiata* (Shlegel). (Copperhead)

Material examined : 1 ex., Reg. No. 24723; Kulumswar, 22.I.79, (Collected by Dr. N. Mazumdar).

Measurement : Snout to vent 1680 mm, tail 380 mm.

Distribution : From Orissa and the Eastern Himalayas (Sikkim) to Southern China, and throughout the entire Indo Chinese subregions.

FAMILY : ELAPIDAE

19. *Bungarus fasciatus* (Schneider). (Banded krait)

Material examined : 1 ex., Reg. No. 24471; *ca.* 5.km.E. of Bijapur, 8. VI. 80, (Collected by D.P. Sanyal & Party).

Distribution : Eastern India.

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THE IMPACT OF HUMAN ACTIVITIES ON THE STATUS AND DISTRIBUTION OF AMPHIBIANS IN PAKISTAN

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ABSTRACT: Human activities may be beneficial or detrimental to amphibian populations in the plains of Pakistan. Threats to amphibians as well as advantages brought by development activities are described. Suggestions for protecting the more vulnerable species have been made.

Several factors are responsible for the compositions of the amphibian fauna in the plains of Pakistan, including geographic accesibility. The microhylid genus *Microhyla* is essentially tropical, invading the plains of northern Punjab comparatively recently (Khan, 1974, 1980, 1985). The genus *Bufo* radiated out from North America during the Cenozoic and invaded Eurasia twice, first establishing in Indo-Malayan region (broad-skulled *melanostictus* group), later invading the Himalayan upland and evolving into the taxa: *melanostictus, parietalis* and *himalayanus*. During the second invasion, which was directed to the European region, the narrow skulled *viridis* group entered and later speciated in the Indo-Gangetic plains and Himalayan region into the taxa: *stomaticus, fergusoni, olivaceous, surdus, viridis, raddei, latastei* (Inger, 1972). The ranid genus *Rana* differentiated in tropical Africa during the Cenozoic and radiated out to different parts of the world (Savage, 1973). In the Indian subcontinent, it differentiated into the highland Himalayan subgenus *Paa* of which four forms have been recorded from Pakistan: *barmoachensis, hazarensis, sternosignata,* and *vicina* (Dubois and Khan, 1979; Khan and Tasnim, 1989). The subgenus *Euphlyctis* (=*Dicroglosus*) is represented by the taxa *cyanophlyctis, tigerina, limnocharis,* and *syhadrensis*. *Tomopterna* is represented by the single taxon *T.breviceps* (Khan and Tasnim, 1987).

Subtropical conditions in parts of Pakistan support a grass-land biotape. Originally a part of the Indo-Gangetic plain, it has a riparian type of faunal distribution. Extensive canalization has drastically changed the topography of the plains of Punjab and Sindh during the past century, affecting amphibian distribution.

OBSERVATIONS ON ANTHROPOGENIC PRESSURES

I have been studying the effect of human activity on amphibian populations and their distribution since 1963. Human intervention in the natural environment has affected the local amphibian fauna in two ways:

i) adversely, by destroying natural habitat, and

ii) favourably, by creating new habitats.

The same change may be adverse for some species and favourable for others.

ADVERSE EFFECT OF HUMAN ACTIVITY: Human needs have grown with the extensive growth in the human population and this has necessitated boosting agricultural production to meet the ever-growing needs. At governmental level, efforts are being made to keep pace with the advances in science and technology. Various measures taken, have been shown to have affected the world's frog fauna adversely (Dodd, 1977; Barclay, 1980).

a) INDUSTRIALIZATION: Large tracts of land have been acquired to set up various types of industry, mainly in the suburbs of large cities and

towns, which were once water catchment areas where amphibians bred during the monsoons. The original vegetation provided the amphibians with suitable habitats for reproduction and development. Levelling of these areas has adversely affected the local fauna and flora. The population of the cities in Punjab (Lahore, Gujranwala, Wazirabad, Sheikhupura, Faisalabad, Sargodha, Rawalpindi) have increased enormously during the past decade. Perhaps the most seriously affected frog species are the hydrophyllic forms: *Rana cyanophlyctis, R.tigerina* and *R.syhadrensis*, and also *Microhyla ornata*.

b) URBANIZATION: Villages and small towns and their surrounding areas once supported amphibian populations. Every human habitation used to have a pond, formed by excavations for building houses with earth. During monsoons it was filled with water, and utilized by amphibians for breeding. At present, in a majority of villages, such ponds have been filled, being considered potential breeding grounds of mosquitoes.

c) MECHANIZATION OF AGRICULTURE: Almost all amphibians take refuge during the daytime in holes and crevices in the ground, close to their breeding and feeding grounds. Ox-driven ploughs are slow and do not dig deep; however, the mechanization of ploughing, unearths amphibians from deep holes so that they are crushed under the heavy wheels of the tractor. Thus, the mechanization of agriculture has drastically affected the local amphibian population.

d) USE OF PESTICIDES : It has been contended that crop pests have become a serious problem because of the removal of amphibians from fields. Poisons of several types are sprayed on the crops for controlling pests. The effectiveness of chemicals has always been questioned. Also, they are readily absorbed by the skin of amphibians, often with fatal results. During a survey of 8 sprayed fields of cotton, 489 *Bufo stomaticeus*, 42 *Rana tigerina*, 25 *R. syhardensis* and 14 *R. cyanophlyctis* were found dead. Nearby water catchments, had their entire tadpole populations killed by the washout of the sprayed poison.

e) FUMIGATION OF GRANARIES: Large grain houses have been built recently throughout grain producing areas of Punjab and Sindh. The granaries are surrounded by green compounds, which are periodically watered, attracting amphibians, which take refuge in the granary buildings during the day. The stored grains are periodically fumigated to remove grain destroying pests. During this process all inlets and outlets are closed. Records of the amphibians killed during fumigation of a local granary for four years are given Table 1.

f) CASUALTIES ON ROADS : Observations on a study area in Sharah-e-Mahita, Darul Saddar North, 1 km long and 4 m wide, on the western outskirts of Rabway town, are given in Table 2.

g) USE IN SCIENTIFIC EXPERIMENTATION AND DEMONSTRATION: Amphibians are extensively used for demonstration of biological phenomena and experimentation in laboratories, throughtout the world. On the Indian subcontinent, *Rana tigerina* (often breeding size adults) is one of several species used in schools, colleges and universities.

In Baluchistan, *R. tigerina* is absent, and so the pressure is on *R. cyanophlyctis* and *R. sternosignata*. Degradation of natural habitat and capture for biological research appears to have drastically affected the local populations of these amphibians.

DISCUSSION

Amphibians are intimately linked to marshy and well-watered areas, and are well represented in riparian systems throughout the world (Brode and Burry, 1984; Wiest, 1982; Jones, 1982; Dubois, 1980). The Indus riparian amphibian fauna, though poor in diversity is rich in population (Khan, 1976, 1979, 1980, 1982; Khan and Tasnim, 1987).

The plains of Pakistan were originally a temperate grassland community. Extensive canalization during the last century has carried water to far flung areas which were barren. This has increased the habitat available for the local amphibian species. In 1969, amphibians known from Punjab, Pakistan were *Bufo stomaticus, R. cyanophlyctis, R. tigerina, R. limnocharis* (Minton, 1966; Khan 1974; Mertens, 1969). Later *Microhyla ornata*, (Khan, 1976), *Tomopterna*

TABLE 1: The number of amphibians killed during fumigation of granary in Pakistan.

Year	B.stomaticus	R. tigerina	R. cyanophlyctis	R. syhadrensis
1983	126	6	4	2
1984	245	10	3	5
1985	105	4	7	1
1986	209	7	4	6

TABLE 2: The number of amphibians found killed on a road at Darul Saddar North, Pakistan.

	Feb	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1985	42	86	129	220	210	40	23	225	11	1	0
1986	34	109	264	98	134	44	20	321	22	5	0

breviceps and *R. syhadrensis* (Khan, 1976) were added to the list. This indicates how the creation of suitable habitat in the plains of Punjab has extended the distribution of frog taxa.

Road construction is an important element in urbanization schemes. Roadside excavations are soon filled with water and colonized by breeding amphibians. I have observed the colonization of such excavated pits on the sides of the pit of Sargodha-Faisalabad Road, during its renovation and widening in 1986, between Rabwah city and Ahmed Nagar. Fourteen pools were created, which were used by almost all the local amphibian species for breeding. Our study on the reproductive strategies of amphibians resulted from our earlier observations in the area (Khan and Malik, 1987). Though a great majority of the roadside puddles are shortlived, killing the amphibian larvae in the premonsoon period by drying up, they are kept filled during the monsoons by periodic rain and are used successfully by the amphibians then. (Dubois 1980).

Paddy fields are the main breeding sites of amphibians throughout the plains of Punjab and Sindh. During the monsoons, these rice fields are filled with water and invaded by several amphibian species. Water level is maintained in the field and allows the species to complete their development. Areas recently reclaimed are being converted to grow paddy, helping in the wider distribution of amphibians forms.

Floods have played a major role in the distribution of the herpetofauna (Khan, 1980). Floods in the Punjab rivers are almost an annual feature. Wide tracts of land are washed away, and amphibians are carried far and wide throughtout the country, allowing them to colonize new areas.

Urbanization and land reclamation activities have sometimes helped in creating suitable habitat and widen the distribution of a majority of the amphibian species. Crops which provide moisture and cover from the summer heat and premonsoonal watering of the crops often help amphibians to breed. At the same time, the periodic spraying of chemicals on crops greatly affects the local amphibian populations. Minimizing use of non-specific pesticides in favour of biological control techniques would save millions of frogs. Large numbers of amphibians are crushed on roads. A book "Amphibians and Roads", has been published, expressing serious concern about this problem (Langton, 1989). Making people aware of amphibian breeding areas near roads and signs advising drivers to drive slow there could help. Many thoudsands of amphibians are killed by fumigation of granaries, which could be minimized if all the inlets close to the ground of granaries are gauzed to prevent entry by frogs and toads. Extra care should be taken in biological research institutes in minimizing the number of frogs used in lab dissection.

Amphibians eat vast quantities of insects pests and are an interesting part of our natural world. Human activities can either help or destroy popu-

lations of frogs and toads. In Pakistan an awareness needs to be created to make sure we help our amphibian population to survive and thrive.

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REVIEW

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SEVEN CROCODILE BOOKS

In the past two years we have received seven books on crocodilians, a virtual flood of books after a long drought.

Two of these are serious, lavishly illustrated tomes packed with information about the world's crocodilians. "WILDLIFE MANAGEMENT: CROCODILES AND ALLIGATORS" resulted from a crocodile symposium organized by the Conservation Commission of the Northern Territory in Darwin, Australia, in 1985. It was a wild gathering with a heavy measure of Aussie hospitality, and after the fun was over, the three key organisers: Grahame Webb, Charlie Manolis and Peter Whitehead edited the symposium into this readable volume. Contributors include "hands on" crocodile workers from every part of the world with crocodile populations and the subjects range from the distribution and status of the world's crocodilians (by Red Data Book compiler Brian Groombridge) to crocodile egg chemistry by Charlie Manolis and colleagues in the Northern Territory crocodile programme. We have long been getting copies of scientific papers on crocodiles and alligators by crocodile people from all over the world. But it was particularly gratifying to see state of the art crocodile survey, management, husbandry and breeding biology in one package by such luminaries as Angus Bellairs, Ted Joanen, Harry Messel, Dave Blake, Jeff Lang and Mark Ferguson.

This is a 550 page, big format book that can be scanned, selectively read and enjoyed by anyone interested in the charismatic, huge reptiles that have outlived the dinosaurs. It is also a valuable addition to a natural history reference library, a book which summarizes our present knowledge of crocodilians and points the way to research and conservation strategies for the future.

Close on the heels of the "Wildlife Management" book came "CROCODILES AND ALLIGATORS" which is subtitled "An Illustrated Encyclopedic Survey by International Experts". Edited by Andy Ross, who works at the Smithsonian Institution, this book concentrates on giving the reader an introduction to the world's crocodilians, emphasizing crocodiles in the wild. It is full of exciting photographs, characteristic of the Weldon Owen series (which includes a book on whales and one on sharks) and would be worth owning just for the pleasure of browsing through these pictures. The text is written by thirty one specialists in various aspects of crocodilian biology and is on the whole easily readable, though the section on evolution will leave a lot of readers far behind. "Crocodiles and Alligators" is the best popular book on the subject to appear since the early 70's when W. T. Neill came out with his "Last of the Ruling Reptiles" and C. A. W. Guggisberg's "Crocodiles" book was published. But I don't agree with changing the popular name of the salt water crocodile to "Indo-Pacific" crocodile. This is the biggest, most dangerous and highly respected of all the crocodiles. It will remain the "salty" of croc people all over the world, it's certainly not going to become the "Indo". But aside from a little nit-picking this is the croc book all of us have been waiting for.

And now into the five "pop croc" books, four of which have emerged from Australia on the heels of "Crocodile Dundee" and the widely publicized crocodile attacks in northern Australia. The first "CROCODILES OF AUSTRALIA" is by Grahame Webb and Charlie Manolis. They also produced a documentary "Living with Crocodiles" as part of their awareness raising efforts in the Northern Territory. Crocodiles are difficult animals to create sympathy for. They are not pandas or colourful birds. Even tigers have a much better publicity rating. But Grahame and his gang have helped the crocodile to become the symbol of Northern Territory, a major tourist draw and an important, managed wildlife resource.

"Crocodiles of Australia" is targetted for the widest possible audience. It has a general

introduction to crocodiles the world over and then goes into the Australian "salty" and then "freshy" (Johnston's crocodile). The photographs are excellent and the section "Crocodiles and Man" is especially informative and interesting. Even though its focus is on the Australian crocodiles, Webb and Manolis's book is entertaining, useful as a reference and a good introduction to the crocodile world.

Rodney Steel, a journalist formerly with the British Museum of Natural History, came out with "CROCODILES" in 1989. It has a textbook format with a lot of useful basic information on the world's crocodilians. We would however, hope that people would start calling the gharial by its real name and forget the mistaken "gavial". There are several good colour plates and adequate maps and line drawings, though sometimes misleading. For example, seeing the line drawings on page 131, you would think that a false gharial has a thinner snout than the gharial. Map 12 on page 139 puts the gharial down into Gujarat, way south of its western distribution, neglects the Chambal River, carries it south of the Mahanadi to the Krishna River and infers the single Burmese record to mean that it is found all the way into the Indo-Chinese region. There is the inevitable discussion about biggest crocodiles on record which leaves out the skin measured by Jerome Montague and myself at Komovai Village, Fly River, Papua New Guinea. This is a record published by the Guinness people, a saltwater crocodile of 6.2 meters, just a little over 20 feet long.

With a title like "CROCODILES, KILLERS IN THE WILD" you wonder what author Neil Hermes is trying to do for the already well maligned crocodiles of the world. Then you look at his distribution map for the salt water crocodile on page 10 where he puts the salty up into the Himalayas, the photo of the subadult salty on page 11 captioned "large" Estuarine Crocodile, or the salty called a Johnston's crocodile on page 54. But at least the author is sensitive to the complex arguments for and against conservation of crocodiles. The chapters "Crocodile Ranching", "Endangered Species" and "The Future" make a good summary of balanced opinion on how crocodiles can be respected and appreciated instead of loathed.

"CROCODILES OF AUSTRALIA" By Greg Biddell and Col Stringer is similar in format and content to Hermes's book. There are some good photographs in the book (especially the old ones), interesting drawings and an objectivity in the text that is mainly informative. Sometimes the authors use their imagination or quote folksy beliefs as fact, for example the male salty tail-slapping its mate as a sign of affection. The crocodile is called an amphibian in this book. It certainly is amphibious in its habits but remains a reptile nevertheless, not a frog! The book contains a lot of anecdotal tales about crocodiles which are entertaining and give some insight into Australian attitudes towards the animals.

The seventh crocodile book, "CROCODILE ATTACK IN AUSTRALIA" is by Hugh Edwards, an author, diver and adventurer. In spite of the gory sensationalism of the title and subject, the author does try to bring in an element of balanced opinion. He rightly points out the stark difference in attitude toward crocodiles that exists in Australia. In Northern Territory people are learning to live with crocodiles. In Queensland, vigilante groups go out at night and shoot up crocodile populations in defiance of the protective laws. The bulk of the book is devoted to analytical descriptions of the recent, well-publicized crocodile attacks in northern Australia. Recent victims included three women, one an attractive American model and one, Val Plumwood, who survived the attack on her, but barely.

These descriptions are sometimes gruesome but do teach a few lessons, the most important being don't swim in croc country and, expect the unexpected. Crocodiles kill very few people, especially when compared with the carnage we create with our motor vehicles. The number of people killed on India's roads probably touches 50,000 each year (it does in the U.S.). This is much more than the number of people killed worldwide by crocodiles in the past 100 years!

But it curdles our blood to think about being caught by a wild animal, especially by a reptile. It doesn't matter that the odds are very much with us: humans kill several hundred thousand crocodilians each year and some of the species are very close to extinction at our hands. "Crocodile Attack" wraps up with a few chapters about crocodile management and the future of crocodiles. Quoting Grahame Webb and Harry Messel, the best known Australian crocodile biologists, the author gives us an idea of how research findings have guided policy and the imaginative management programme set up by the Northern Territory Conservation Commission.

1. WILDLIFE MANAGEMENT: CROCODILES & ALLIGATORS 1987 by G. Webb, C. Manolis, P. Whitehead, Surrey Beatty & Sons, 43, Rickard Road, Chipping Norton, N.S.W. 2170: 552 pages
2. CROCODILES AND ALLIGATORS Edited by C.A. Ross 1989 Weldon Owen Ltd. 43, Victoria Street, McMahons Point, N.S.W. 2060, Australia Aus.$ 40.00 : 240 pages.
3. CROCODILES OF AUSTRALIA by G. Webb and C. Manolis 1989 Reed Books Pty. Ltd., 2 Aquatic Drive, Frenchs Forest N. S. W. 2086, Australia. Aus. $ 25.00 : 160 pages.
4. CROCODILES by Rodney Steel 1989 Christopher Helm Ltd., 21-25 North Street Bromley, Kent BR1 1SD : 198 pages
5. CROCODILES KILLERS IN THE WILD by Neil Hermes 1987 Child & Associates, Ltd., 9 Clearview Place, Brookvale, N.S.W., Australia 2100 : 64 pages
6. CROCODILES OF AUSTRALIA by Greg Biddell & Col Stringer 1988 Adventure Publications, P.O. Box 40688, Casuarina, N. T. Australia. : 80 pages
7. CROCODILES ATTACK IN AUSTRALIA by Hugh Edwards 1988 Swan Publishing Pty. Ltd., 55, Lavender Street, Milsons Point Sydney, N.S.W. 2060, Australia : 192 pages

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NOTES

Hamadryad, Vol.15, No 1 pp 28 1990

NOTES ON CAPTURE OF THE SPINY-TAILED LIZARD *(UROMASTYX HARDWICKII)* IN GUJARAT

THE spiny-tailed lizard (*Uromastyx hardwickii*) is patchily distributed in the dry, arid zones in the north Indian states of western Uttar Pradesh, Rajasthan and Gujarat. This small-headed lizard with a flattened, bulky body and thick, spiny tail lives in zig-zag burrows that are self-excavated, one to two meters long. The lizard is active at dawn and dusk, when it is seen foraging and sometimes basking, alert to signs of danger, bolting into burrows when threatened.

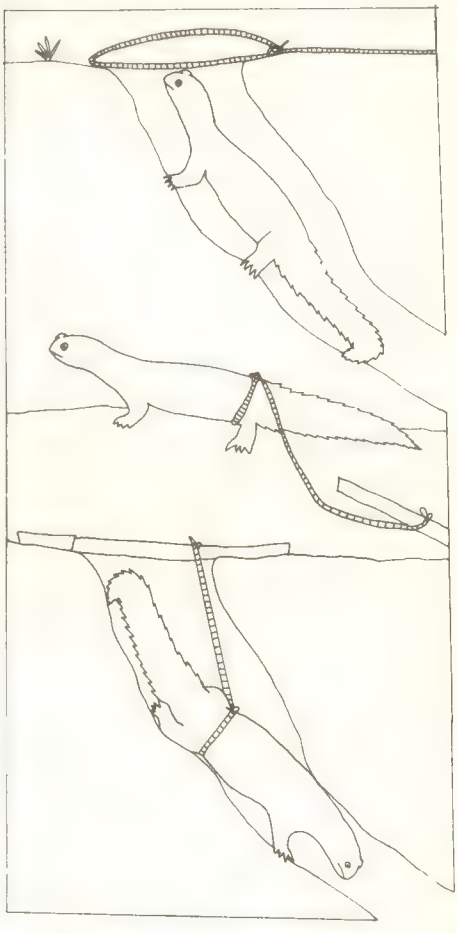
A large population of the lizard exists in the Little Rann of Kutch (part of the 4,953 sq km Kutch Wild Ass Sanctuary). During surveys of the herpetofauna of Gujarat, I observed several methods used by the Vaghari, Koli and Harijan communities to catch these lizards:

When lizard colonies are located, each burrow is dug out with the help of a crowbar and the animals caught by hand. In places where the earth is too hard to be dug up, a long, flexible metal wire is used to worry the lizard out into the open. When water is available, burrows may be flooded.

Perhaps the commonest method and one that requires less labour is using a plastic noose, tied to the end of a stick, 15-20 cm long. The nooses are set at the entrance of the lizards' burrows. The noose passes through the body, up to the hind limbs, snaring the body at the waist (Fig.1). Using this method, a trapper may catch 50 - 80 lizards in a day.

After breaking the backbones of the lizards, the trappers sell their weekly collections of lizards to a local animal dealer. The eventual fate of many of these lizards is the boiling pan in cities and villages where the fat of the animals is sold to gullible customers as a potent aphrodisiac. Significant numbers are also exploited for meat. I estimate that 4,000 - 5,000 animals are trapped annually from different parts of Gujarat, with 2000 - 3000 animals sold in the markets of Ahmedabad city alone.

FIG. 1 : Trapping Method Used as Described in Text



Uromastyx hardwickii is protected under Schedule II of the Indian Wildlife (Protection) Act, of 1972 and in the recent past, the Gujarat Forest Department confiscated large numbers of these lizards from the Sunday markets and dealer shops in Ahmedabad.

Mr. Sarfraz Mallik and the animal dealers of Ahmedabad city provided information on the sale of *Uromastyx*, for which I am grateful.

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SCRUBLAND *CALOTES NEMORICOLA* ?

BETWEEN 1970 and 1974, a series of papers appeared in journals published on four continents on various aspects of the field biology and physiology of *Calotes nemoricola* (Subba Rao, 1970, 1972; Subba Rao and Rajabai, 1972, 1972a, 1974). The specimens reported on, had been collected near the Sri Venkateshwara University Campus in Tirupati (13° 8" N and 79° 4"E), Andhra Pradesh, in southeastern India.

Previous literature (eg. Gunther, 1864; Smith, 1935) indicates that *Calotes nemoricola* is a species of the forests of the Western Ghats including the Nilgiris, a region floristically and faunistically quite dissimilar to that of the rest of India, with a unique herpetofauna (see review by Jayaram, 1974). Subba Rao did not comment on the assignment of the name, nor on the assumption that a species endemic to mesic forest could occur in scrubland (see below). No voucher specimens were deposited in any major museum.

The habitat was described (Subba Rao, 1970; Subba Rao and Rajabai,1972) as "fields . . . scattered with small rocks, stones and pebbles of quartzite with shrubs". This may be categorised as scrubland, and is drastically different from the evergreen forests of the Western Ghats (see description in Subramanyam and Nair, 1973); for instance at Tirupati, the highest air temperature in the month of May is 40°C (Subba Rao, 1970), much higher than any temperatures recorded in the forests of the Western Ghats.

The brief description (Subba Rao, 1970) of the male *"Calotes nemoricola"* (swollen cheeks, a gular pouch and tail base swollen with thick scales, in addition to a dorsal crest), leaves the identity of the species involved uncertain. However, only a single arboreal species of agamid has been reported to occur in the eastern coastal region of India. This is the widely distributed and locally abundant garden lizard (`bloodsucker'), *Calotes versicolor*.

At least one worker, Murthy (1985), has included Tirupati in the distribution of *Calotes nemoricola*. Murthy (1985a) illustrates what appears to be *Calotes versicolor* from Tirupati (Murthy, *pers comm.*) taken by Dr. B. S. N. Reddy, one of Dr. M.V. Subba Rao's co-workers (plate VIII, Fig.2), but captions it *'Calotes nemoricola'* (sic). The animal depicted lacks the oblique fold in front of the shoulder, a diagnostic feature of the complex of *Calotes* to which *C. nemoricola* belongs.

In view of the fact that the animals studied by Dr. Subba Rao appear to be *Calotes versicolor* and that ecology, climate and other factors are in accord with this, the Tirupati record of *Calotes nemoricola* should be removed from the fauna of Andhra Pradesh and the range of this species should remain as the "Western Ghats".

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BIOLOGY OF THE INDIAN GARDEN LIZARD, *CALOTES VERSICOLOR* (DAUDIN)

PART I : MORPHOMETRICS

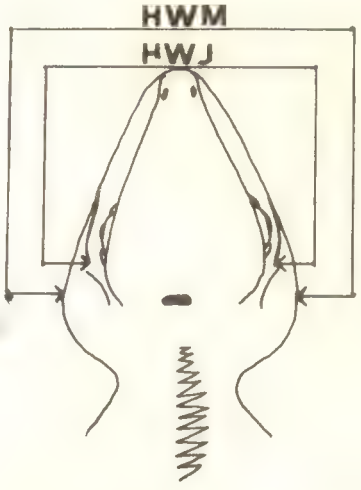
THE Indian garden lizard *(Calotes versicolor)* occurs from Afganistan to the Indo-chinese subregions (Smith, 1935), and is probably the most frequently seen lizard on the Indian subcontinent. It is a common sight in the Indian countryside, in the typical pose : the hindlimbs hooked onto tree bark, the lower abdomen touching the tree, forelimbs almost fully stretched and the head propped up. Females are generally smaller, stay in the bushes and only the bigger ones exhibit a male-like stance.

No long term studies have been done on the species. This paper is the first part of a series on the biology of *C. versicolor* and deals with morphometrics of the population under investigation.

All specimens studied were caught and observed between 2 April and 18 May 1990, within the Madras Crocodile Bank (approx. 8 acres) and its surrounding areas in Vadanemmeli, Chengai Anna (formerly Chingleput) district, Tamil Nadu, South India. Males outnumbered females in this study, presumably because they were more conspicuous, being larger and taking up more prominent positions. Lizards were caught during the day with a noose fixed to the end of a stick or a fishing rod. A black noose worked best as it went mostly unnoticed by the lizards even when it brushed over their snouts - though at times the lizards flicked their tongues, perhaps mistaking it for prey.

For 36 specimens, we determined total body length (TBL), snout-vent length (SV), tail length (TL), head width at the jaws (HWJ) and at the widest point (HWM), (Fig. 1) using dial vernier calipers or a metal foot rule, and body mass, using a Pesola balance (230 to 1000 gms) and/or Acculab digital scale (1 to 230 gms). The number of upper labials (UL), lower labials (LL) and midbody scales (MB) were counted. The animals were usually sexed by their morphological characteristics (body mass, comparative width of head, dorsal spines, colour pattern and external examination of the intromittent organs by probing). Colour nomenclature follows Smith (1975). Colour was noted from captured animals; free-ranging animals were observed to be brighter.

FIG. 1 Variation in the Head width at the Angle of the Jaws and the Gular Sacs



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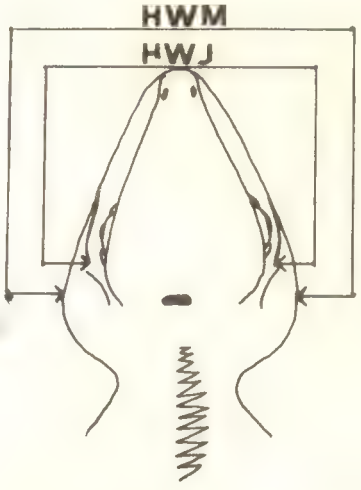

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Males are larger than females (to 132 cm SV), with a prominent row of dorsal spines running down the middle of the back and distinct gular sacs and cheeks. The colour of the head varies from a brownish olive to a yellow ochre with a black band running round the neck. The dorsal surface of the body is typically yellow ochre, sometimes with blotches varying from a tawny brown to a mars brown, and the limbs are generally drab grey mottled with hair brown.

Females are smaller than males (to 99 cm SV) and have proportionately shorter dorsal spines and lack the swelling on the gular regions. The colour of the head varies from a grayish horn to a clay colour. The body usually has prominent dorsal bands of burnt umber, cinnamon brown and olive grey flanked on either side with a latero-dorsal stripe of buff yellow. Male TBL ranges between 290.0 and 445.0 (x = 394.0 +/- SE 4.91) mm, SV from 95.0 to 132.0 (x = 119 +/- SE 0.89) mm, TL from 175.0 to 320.0 (x = 275 +/- SE 4.46) mm. HWJ ranges from 15.15 to 24.4 (x = 20.6 +/- SE 2.29) mm. HWM varies from 15.65 to 36.1 (x = 28.4 +/- SE 5.39) mm. The lightest male weighs 25.9 and the heaviest 92.8 (x = 64.53 +/- SE 19.39) gms. For females, TBL ranges from 248.0 to 350.0 (x = 305.0 +/- SE 3.64) mm, SV ranges from 68.0 to 99.0 (x = 84.0 +/- SE 1.1) mm, TL from 180.0 to 252.0 (x = 222.0 +/- SE 2.52) mm, HWJ from 4.25 to 16.4 (x = 12.6 +/- SE 3.18) mm, HWM from 6.35 to 18.85 (x = 13.67 +/- SE 3.4) mm. The lightest female weighs 8.0, the heaviest 28.6 (x = 15.89 +/- SE 7.9) gms. (Table I).

Comparison of the present series with the data given by McCann (1942), shows that the TBL and SV do not differ significantly for the two male populations (test -1.57, p =0.13).

The largest male measured during this study is 445.0 mm whereas McCann reported a maximum length of 447.0 mm. The female population in McCann's study area had a maximum length of 341.0 mm whereas our largest female measures 350.0 mm. The maximum SV and TBL recorded for this species by Smith (1935) are 140.0 mm and 490.0 mm respectively.

SV is strongly correlated to the HWJ in males (r = 0.74) and less so in the females (r = 0.55). In males, the HWM is much more strongly correlated to the SV than the HWJ, r = 0.91; in females, r = 0.67 (Fig 2). The weight in males is only moderately correlated to the SV (r = 0.52), whereas in the females it is very strongly correlated (r = 0.97) (Fig. 3.).

The number of UL varies from 11 to 15 (x = 12.4 +/- SE 0.94) in the males and from 11 to 13 (x = 12.09 +/- SE 0.7) in females. The variation in the LL is 11 to 13 in both sexes (x = 12.15 +/- SE 0.67 for males and x = 12.27 +/- SE 0.78 for females). A combined analysis of male and female data given a range of 11 to 15 for the UL and of 11 to 13 for the LL. For females, the most common value of UL is 12 (54.5% of 11 animals); for males the UL is evenly distributed over 12 and 13 (40% each of 20 animals). In the LL counts, 13 is the most frequent value (45.4%, N = 11) for females and 12(55.0%, N = 20) for males. In a combined analysis of the above data, the most common value is 12 for both the upper (45.1%, N = 31) and lower (48.3%, N = 31) labials (Tables II and IV). Sharma (1982) reports a range of 11 to 16 for the UL of 8 males and of 11 to 13 for the UL of 10 females from Gujarat. The LL counts of his specimens vary from 10 to 13. Underwood (1947), in his studies on the reptiles of Kakinada, Andhra Pradesh, southeastern India, reports a variation of 10 to 14 in the UL and of 7 to 13 in the LL of 95 specimens. The most frequent value given was 11 (46.1% for 171 counts) for the UL and 10 (37.2% for 172 counts) for the LL.

In our sample, the MB counts varies from 40 to 48 (x = 43.26 +/- SE 2.33) in males and from 39 to 46 (x = 43.09 +/- SE 2.30) in females; a combined sample gives a variation of 39 to 48. The most frequent number of scales in females is 45 (27.2%, N = 11) and in males it is 42 and 45 (26.3% each of 19 animals); 45 is the most frequent number (26.6%, N = 30) for both sexes

TABLE I : Statistics of morphometric data of *Calotes versicolor*.

	No. of scales	11	12	13	15
UL					
	Females	2	6	3	-
	Males	3	8	8	1
	Both sexes	5	14	11	1
LL					
	Females	2	4	5	-
	Males	3	11	6	-
	Both sexes	5	15	11	-

TABLE II : Labial counts of *Calotes versicolor*.

No. of scales	39	40	41	42	43	44	45	46	47	48
Females	1	1	1	1	1	2	3	1	-	-
Males	-	3	1	5	1	2	5	-	1	1
Both sexes	1	4	2	6	2	4	8	1	1	1

TABLE III : Midbody scale counts of *Calotes versicolor*.

		N	RANGE	MEAN +/- SE
UL				
	M	20	11-15	12.40 +/- 0.94
	F	11	11-13	12.09 +/- 0.70
LL				
	M	20	11-13	12.15 +/- 0.67
	F	11	11-13	12.27 +/- 0.78
MB				
	M	19	40-48	43.26 +/- 2.33
	F	11	39-46	43.09 +/- 2.30

TABLE IV: Statistics of upper labials, lower labials and midbody scales

		N	RANGE	MEAN +/- SE
TBL				
	M	20	290-445	394 +/- 4.91
	F	10	248-350	305 +/- 3.64
SV				
	M	23	95-132	119 +/- 0.89
	F	12	68- 99	84 +/- 1.12
TL				
	M	20	175-320	275 +/- 4.46
	F	10	180-252	222 +/- 2.52
HWJ				
	M	23	15.15-24.4	20.62 +/- 2.29
	F	12	4.25-16.4	12.6 +/- 3.18
HWM				
	M	19	15.65-36.1	28.4 +/- 5.39
	F	11	6.35-18.85	13.67 +/- 3.4
WT				
	M	17	25.9-92.8	64.53 +/- 19.39
	F	9	8 -28.6	15.89 +/- 7.9

FIG II. Correlation of Snout-Vent to Head Width (at) The Gular Sac in Males and Females

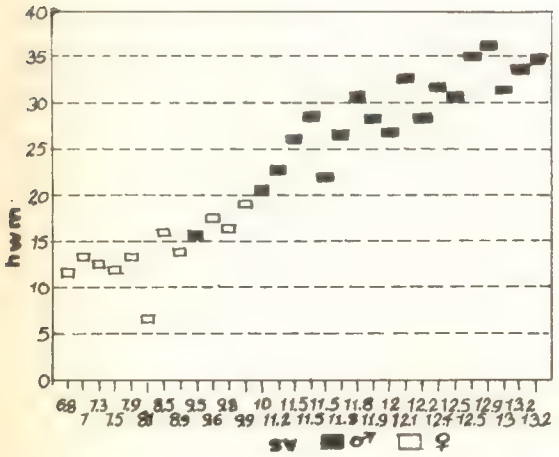
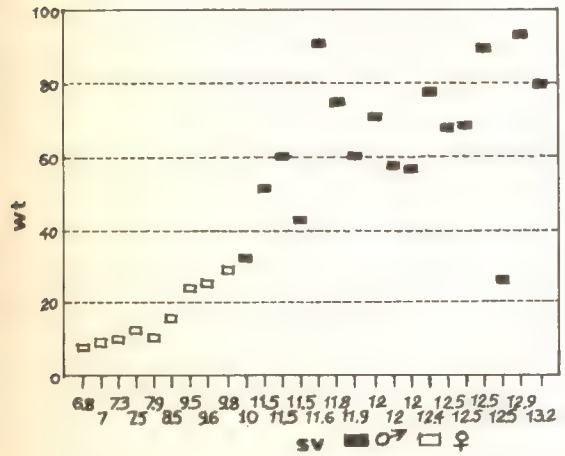


FIG III.Correlation of Snout-Vent to Width in Males and Females



(Table III and IV). Sharma *(op cit.)* reports a variation of 38 to 44 (x = 40.88 +/- SE 0.66) in the MB counts of 8 males and of 35 to 46 (x = 40.30 +/- SE 1.0) in the MB counts of 10 females, with the females having the lowest and highest scale counts. Underwood's animals had MB count that varied from 39 to 48 in a sample of 80 males and 38 to 44 in a sample of 9 females, with mean females MB count being less than that for males. The most frequent MB scale count,in his study, was 41(20.0%, N = 80) in the males and in the females it was evenly distributed over 41, 42 and 43 (22.2% each for 9 animals); 41(20.2%, N = 89) being the most common scale count in both sexes.

Consequently, the population is sexually dimorphic. Males have a larger body mass, a prominent gular region, cheeks and longer dorsal spines. Males also have a brighter colour pattern at the beginning of the rainy season, and other observations indicate that the pattern is seasonal. The sample does not show significant differences in scalation between the sexes.

We thank Indraneil Das, Harry Andrews and Tharaq Andrews for their help and the Madras Crocodile Bank Trust for support of this study.

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ON THE OCCURRENCE OF THE FOREST CANE TURTLE (GEOEMYDA SILVATICA) IN THE WESTERN GHATS OF KARNATAKA, SOUTH INDIA

THE forest cane turtle *(Geoemyda silvatica)* is a terrestrial emydid, endemic to the moist tropical forests of the Western Ghats of south-western India. First described by Henderson (1912), the species was considered rare, and rediscovered only in the early 1980s from the Chalakudy region of Trichur district, Kerala, as well as the districts of Ernakulam, Kozhikode and Idukki in the same state (Vijaya, 1982; Groombridge *et al.*, 1983). A redescription of the species was provided by Moll *et al.* (1986).

A single large female specimen was found in September 1989, in a cardamom plantation in Neria (at 1,200 ft. alt.), Charmadi range, in Dakshin Kannada district, in southern Karnataka. The collection locality lies within a 10,000 acre private land, comprising cardamom and rubber plantations, with a large area of primary forests. This record extends the range of the species north of the Palghat gap. *Measurements* : Straight carapace length : 13.4 cm, straight carapace width : 9.7 cm, straight plastron length : 12.2 cm, notch to notch plastron length : 11.5 cm, shell height : 5.2 cm.

Description : Carapace brownish-grey, plastron yellow, bridge with black blotches. Head brownish. Pupil with a red ring. Patches of red on mandibles. Carapace ridges curved posteriorly.

The specimen, which was collected in the early evening from a rocky biotope, is being kept in captivity for observation. It has a damaged hindlimb with the digits missing. In captivity, it is active at dusk and feeds on millipedes and succulent vegetables.

Locally, the species is called *Kunde aame* (= small turtle), in *thulu*, the language spoken in Dakshin Kannada district.

Other testudinian species recorded from the area include the Travancore tortoise *(Indotestudo forstenii)*, Indian black turtle *(Melanochelys trijuga trijuga)*, Indian flapshell turtle *(Lissemys punctata punctata)* and Leith's softshell turtle *(Aspideretes leithii)*.

I thank Mr. Raghava Hebbar and his family at the Neria Estates, Neria, for their support and encouragement.

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OBSERVATIONS ON SOME VANISHING RELICT LIZARDS OF SRI LANKA

SRI LANKA has a long history of conservation of its flora and fauna, which was implemented by a succession of monarchs commencing from the third century, B.C. (De Silva, 1980). During the extensive clearing of montane forest, from the 19th century, for planting coffee and tea, rainforests shrank drastically and many of their taxa came under pressure. The present report notes the situation for the relict taxa of the agamid genera *Ceratophora*, and *Lyriocephalus* and the endemic taxon *Cophotis ceylanica*.

For the past two decades, I have been making field observations on lizards of the genera *Ceratophora* and *Cophotis* at Nuwara Eliya,

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Hakgala (of Central Highlands, elevation 1,500-1,800 m) and Rangala (of Knuckles at Kandy, Central Province), *Lyriocephalus scutatus* at Kandy (Central Province, elevation 500 m) and Kosgama (Western Province, elevation 30.5 m).

At Nuwara Eliya and Hakgala, large populations of *Ceratophora stoddarti and Cophotis ceylanica* were observed. At Rangala, large numbers of *Ceratophora tennanti* and rarely *Cophotis ceylanica*, and in and around Kandy and Kosgama, a fairly large population of *Lyriocephalus scutatus* were observed. However the number, of these lizards have dropped sharply since the late 1970's. This is specially evident around Nuwara Eliya and Hakgala.

During visits in 1988 and 1989, I have not seen a single member of any of these endemic agamids in the parks on adjoining thickets at Nuwara Eliya and Hakgala. Senanayake (1980) considers the disappearance of these lizards due to the clearing of montane forests, the immigration of the crow pheasant *(Centropus sinensis parrroti)* which reportedly preys on *C. stoddarti*, and of *Calotes versicolor*, a supposedly superior predator. I have never seen *C. versicolor* in the parks of Nuwara Eliya and Hakgala, although *Calotes nigrilabris*, another endemic agamid, was observed as a resident species of these areas. Hakgala is almost free of forest cover at present. Apparently, these lizards are caught by locals for export. However, at least one species *Lyriocephalus scutatus*, appears to be unaffected by heavy logging and clearing of forests, being able to thrive in degraded habitat.

A conservation programme of identifying and protecting the remaining habitats of these unusual agamid lizards and preventing the arrival of any immigrant species that competes with or preys on these taxa is urgently needed.

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COMMENTARY

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THE HERPETOLOGIST AS PHOTOGRAPHER. SHEKAR DATTATRI

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Photographing reptiles and amphibians, even captive reptiles and amphibians, can be a real pain. The subjects are usually highly uncooperative and the 'point-and-shoot' method rarely produces a good result. The three key elements to successful photography are patience, preparation and an ability to previsualise pictures before you shoot.

It might interest you to know that most good herp photographs are shot under 'controlled' conditions. This means an artificially prepared set or a natural space within which an animal is temporarily contained or positioned for the purpose of photography. Photographs that may take years to obtain in truly wild conditions can often be captured within weeks, days or even minutes under properly controlled conditions. This is one secret of herp photography. The other important secret is to shoot ten pictures for every one picture that you need. Professional photographers do this all the time. Do not assume however, that simply shooting ten photographs will automatically ensure one good picture. It is quite possible to produce ten out-of-focus or improperly exposed pictures out of every ten! The goal should be to produce as many good pictures as possible. If you consistently produce many good pictures, sometimes, just sometimes, one might be outstanding.

It's not the camera that's important, it's the person behind the camera. Heard that one before? Well, forget it! The soft, slightly underexposed shot of a very rare lizard or snake that you took with your 'box' camera might give you immense satisfaction but it is unlikely to have an appreciative audience outside your loyal band of admirers. **If** you can afford good equipment, GET IT. However (yes, luckily there is 'however'), superb results are often possible with less than ideal equipment. A cheap set of extension tubes with your normal lens can work almost as well as an expensive 'macro' lens, if properly used. Conversely, an expensive macro lens can produce appalling pictures if you are in competent. The moral behind this is, "successful photography requires proper tools, but proper tools alone do not make for successful photography".

You will be surprised at how many 'good' photographs are ruined by "camera shake". Telephoto and macro lenses exaggerate shake and require very careful handling. The other big problem to watch out for is exposure. Black and white and colour negatives can take quite a bit of under or over exposure while colour slides (transparencies) have very little latitude. The rule of thumb for exposure is: With negative film, expose for the shadows; with transparencies, expose for the highlights. With either kind of film, bracket your exposures whenever possible. Shoot one frame a half stop under the recommended meter setting, one frame at the 'correct' meter setting and one frame at half a stop over the suggested meter setting. Most publishers prefer slightly underexposed slides for publication so having a choice of slides of different densities is usually quite helpful.

The Equipment

There is usually a disparity between what is ideal and what is available. Somewhere in between these two categories is a list of equipment that is essential for good photography. My suggestions based on personal preference are:

1. A fully manual Single Lens Reflex camera (SLR) with a built-in light meter.
2. A 50mm or 55mm Macro lens.
3. A 100mm or 105mm Macro lens.
4. A small but reasonably powerful thyristor flash with an adjustable fresnel lens in front.
5. A good tripod.

The Camera.

The last few years have seen the humble SLR transform itself into a fantastically sophisticated

instrument capable of feats once thought impossible. Most of the new generation cameras include as standard features what were once considered add-on luxuries. Thus we have cameras with built-in motor drives, automatic multi-pattern metering, autoexposure in a half a dozen different ways, auto focus and auto bracketing. The choice is mind boggling. Unless that is, you happen to live in a tropical or third world country. For you and me there is only one choice. The good old manual SLR. Sophisticated electronic cameras invariably suffer in a humid tropical atmosphere and servicing facilities are inadequate in third world countries. The manual SLR is a simple machine and is less likely to break down. What you need essentially is something that is easy to operate, rugged and reliable. Although such cameras are becoming increasingly scarce, some manufacturers are still making them. Better get yours while stocks last.

The Macro Lens

If you are buying a new camera you can ask for a 50mm or 55mm macro lens in lieu of the usual 50mm Standard Lens that is sold with most SLR's. A macro lens can focus much closer than a standard lens thus providing greater magnification. It is usually more expensive than the standard lens but the difference is not too big when you do the switch at the time of purchase. If the dealer who you purchase the camera from does not have a macro lens, just buy the camera body and shop around for a lens elsewhere. However, do not buy a cheap substitute. The camera maker's macro lens may be more expensive but will invariably be of better quality. Macro lenses are as a rule slightly slower than standard lenses (ie., their maximum apertures are smaller), but I have never found this a cause for concern. Since your 50 or 55mm macro lens will also double as a normal lens for taking regular photographs, buying it makes sound sense in more ways than one.

A longer macro lens such as a 105mm or 200mm is a great help for the closeup photography of shy or dangerous subjects, as it will enable you to fill the frame with a subject while standing away from it. A longer macro lens also gives you more working room, a great help when you are using artificial lighting.

Many modern zoom lenses have a macro setting and can be used for taking close-up photographs. Although this facility adds a further convenience to the already versatile lens, zoom lenses have not been designed specifically for macro work and the results will be less satisfactory than what can be obtained with a regular macro lens.

If you can't afford a macro lens there are cheaper ways of producing good close-ups. A set of extension tubes can be purchased for a fraction of the cost of a macro lens and can be used to great advantage once you are aware of its limitations. Extension tubes are versatile. You can buy them singly or as a set of three, each one of the set being of a different width, to enable you to achieve different degrees of magnification. You can use them singly or in any combination you choose depending on the amount of magnification required. Extension tubes can be used on almost any kind of lens but are particularly suited for use with normal (50mm) or telephoto lenses. What they do is essentially reduce the minimum focussing distance of a lens thus increasing its magnifying capacity. However, there is a major drawback to extension tubes. They reduce the amount of light reaching the film. This reduction can be slight or substantial depending upon the extension involved. As a result you have to compensate for this light loss by increasing the exposure. A bellows unit which can provide continuous variable magnification is even more versatile than extension tubes but a good set is also many times more expensive. Before using any extension device for photographing herps, it helps to first experiment on small, static subjects.

Only auto extension tubes or bellows will couple with your camera's meter. And while your built in camera meter may or may not give you accurate readings at extreme close-up (a simple test should tell you how much to compensate, if compensation is indeed necessary),

you will definitely need some guidance on exposure compensation when doing flash photography with extension tubes or bellows. While it is beyond the scope of this article to go into the intricacies of exposure compensation here are a few tips for starters.

The greater the magnification the greater the increase in exposure required. If your magnification is 1:1 or exactly life-size, treat your ASA at 25% its normal speed. That is, if you are using 64 ASA film you should treat it as if it was 16 ASA film and expose it as if it was 16 ASA film. This is all the compensation you will have to do. If your magnification is 1:2 or half lifesize treat your film at 44% of its ASA speed (Eg. 64 ASA X 44 / 100 = 28). Your effective ASA rating at half life-size magnification with the use of extension tubes for flash photography is 28 ASA instead of 64 ASA.Bracket your exposures for safety.

Finding out the magnification is quite simple. All you have to do is place a millimeter scale in front of the lens and move the camera back and forth till the scale appears in sharp focus. If you can see 36 millimeters across the frame then your magnification is 1:1 or exactly lifesize (because the 35mm frame is actually 36 millimeters wide). If you can see 72 millimeters across the frame then your magnification is 1:2 or half lifesize, and so on.

Macro photography is also possible with the use of filter type diopter lenses that screw on to the front of a lens. The standard 50mm lens is best suited for use with these diopter lenses, although they can also be used on telephoto lenses. Diopter lenses can be purchased singly or in a set of three and can be used singly or in combination. When purchased as a set they come in strengths of +1, +2 and +3. When used together it is recommended that the most powerful one be closest to the front of your camera lens. The warning against cheap substitutes holds good here also. It is better to buy the best ones you can afford.

Diopter lenses are convenient to use and their greatest advantage over extension tubes is the fact that absolutely no exposure compensation is required. While you cannot expect the same sharpness and resolution from diopter lenses as from a macro lens or through using a good camera lens on extension tubes, they do their job well and as long as you do not expect to make extra large enlargements of your pictures (12 x 10 inches and above), they will prove quite satisfactory.

There is one last extremely low budget way of doing close-up photography. You can mount a simple device known as a lens reversal ring on your camera body and then screw your standard lens onto its **backwards**. I am not very much in favour of this technique for two reasons. 1.because it exposes the back element of your lens,which might get scratched and 2. because its use has very limited potential. However, it is an inexpensive technique that could give remarkable results in certain situations. Try it for what it is worth!

Flash

A small but powerful thyristor flash is invaluable, for the herp photographer will have to rely a great deal on artificial illumination. The thyristor circuitry in the flash provides rapid recycling. The better models have a manual switch for controlling the intensity of the flash all the way from full power to 1/16th or 1/32nd of its total output. This facility is useful in many ways.

1. It allows you greater control over depth of field.
2. It allows you to fire the flash from very close to your subject during macro photography without problems of overexposure.
3. It gives you greater control over freezing movement.
4. It makes fill-in flash easy and precise.

Thyristor flashes usually have 2 to 3 'automatic' settings that help in obtaining precisely exposed flash pictures consistently. My flash has 3 automatic settings. First I set the ASA in use and then choose the auto setting that I want. Say I'm using 100 ASA film, my first auto setting will tell me to set the apeture on the camera at f 5.6 if

Common toad *(Bufo melanostictus)*
Nikon 105 mm, flash

2. Saw scaled viper *(Echis carinatus)*,
Nikon 105 mm, f11, 1/125

King cobras *(Ophiophagus hannah),*
Nikon 105 mm, ring flash

Olive ridley *(Lepidochelys olivacea),*
Nikon 50 mm, fill-in flash

I am working between 0.5 and 3.5 metres. I can go to any position within this range and get perfectly exposed pictures because the light sensitive eye of the flash automatically regulates its output according to the distance from the subject! My second auto setting will tell me that I can set an aperture of f4 and work between 1 and 7 metres, and so on. I can also flip the switch to the manual mode on the flash and control my working aperture to achieve the precise results that I want. As we shall see later, this facility can be exploited to get superb results with fill-in flash.

Many of the better models of thyristor flashes offer useful accessories as well. My flash used in its original form has a angle of coverage equivalent to that of a 28mm wide angle lens. By affixing a simple "telephoto attachment" to it I can, at will, alter the angle of coverage of the flash to suit a 35mm lens, a 50mm lens or a 135mm lens.

Techniques

The Tripod.

A good tripod can enhance the quality of your pictures tremendously. It is not always practical to use a tripod but I speak from experience when I say that a tripod is often not used even when it is essential out of **sheer laziness**. Apart from being able to provide rock steady pictures, a tripod is also a useful place to park your camera as you move around the set adjusting the light or subject. It facilitates precise composition and generally gives you greater creative and technical control over your photography. However, a flimsy tripod is no better than none.

A **monopod** offers more freedom of movement while providing a fairly good support for steady pictures, particularly when using telephoto lenses. Of course you can also simply use a stool or a bean bag or whatever to provide support for the camera. The idea is to produce shake-free pictures by whatever means.

Flash Photography

You can't make an animal lie in the sun for a picture if it doesn't want to stay. Most amphibians can get dangerously dehydrated if left out in the sun overlong and no self respecting reptile will on its own accord oblige you by posing in full sunlight for any length of time. This is where electronic flash proves its value. The momentary - even if somewhat blinding - nature of the illumination and the almost imperceptible heat it produces makes flash a light source superior to other forms of artificial lighting for herp photography.

The main problem you might encounter with flash is that most flash pictures **look** like flash pictures. The background tends to 'black out' and the subject sits in a harsh glare of flat light. However, with a little bit of practice and intelligent experimentation, pictures taken with flash can be made to look like daylight shots.

If you are using a single flash, just holding it slightly to one side of the camera will result in more pleasing pictures. By adding a second, carefully placed flash greater control can be exercised on the depth and dimention to be perceived in a picture. Adding a third flash to selectively light the background can absolutely transform your picture. Creativity with flash is only limited by your own imagination!

Several flashes can be linked to a camera with long cords going out of a multipin distributor plugged into your camera's flash socket. Or you can avoid cords by using slave units - small photo-sensitive devices - attached to your auxiliary flashes. When the master flash goes off, the slaves pick it up and trigger the other flashes, all in perfect synchronisation.

The ring flash

You can greatly simplify macro flash photography by using a ring flash. A ring flash, as its name indicates, is a circular flash that attaches to the front of your lens to provide shadowless illumination. It is powered by a powerpack which either sits on the camera's hotshoe or separately. While a ring flash takes the drudgery out of flash photography it is not without its limitations. Any reflective surface photographed with a ring flash bears the unmistakable reflection of the ring (which you may or may not like). This refelection is most

noticable in the eyes of animals photographed with this device.

I try to minimise this effect by using a longer macro lens like a 105mm and being further away from the subject. Whereas the ring can still be seen in a reflection, it is smaller by virtue of the flash being further away from the subject than it would be if I had used a 55 macro for the same purpose. The photograph of the baby king cobras hatching was taken with a ring flash on a 105mm macro lens. The reflection of the ring flash can be seen in two places. The other drawback of ring flash is that while it produces beautiful results with colour film, photographs taken with black and white film tend to look very flat.

Fill-in flash

To me one of the greatest advantages of flash is its use as a source of fill-in illumination. By using flash carefully in conjunction with daylingt, ordinary pictures can be transformed into extraordinary pictures. Enhanced clarity, colour rendition and sharpness are the rewards of intelligent fill-in flash photography.

While photographing olive ridley sea turtles *(Lepidochelys olivacea)* at Gahirmatha beach in Orissa several years ago I spied a female returning to the sea after laying her eggs just as dawn was breaking. As I ran towards her I took a meter reading of the pink sky behind the turtle. The F-stop indicated was 1.4. Using the manual output selector on my flash I set it so that it indicated f 1.4 and shot the photograph that is printed here. The turtle that was just a dark meaningless blob on the beach with the bright sky behind was now perfectly illuminated by the flash. Thus by matching the intensity of the flash with that of available daylight, a pleasing picture could be produced.

The Subject

There are two kinds of photographic situations you will encounter. First something might suddenly happen when you least expect it and you will have to grab your equipment and make the best of the situation. Quick reflexes, confidence and complete familiarity with your equipment is absolutely essential.

The bizarre photograph on the back cover is the result of something that happened unexpectedly one evening eight years ago. I was idly observing some water monitors *(Varanus salvator)* at the Madras Snake Park one day. It was not particularly exciting as they were just lazily lying around. As I was about to leave a common monitor *(Varanus bengalensis)* that had been residing for several months in the same pen descended the tree it had been resting on. The instant it touched the ground a big male *salvator* lying close by grabbed him by the head and proceeded to swallow him without any hesitation whatsoever! Whatever little light there was in the enclosure was patchy so I fixed a flash for fill-in and got some unusual shots with my 200mm.

The other kind of situation, shooting under 'controlled' conditions can also provide exciting picture opportunities if you have the patience. However, to successfully restrain your subjects for the duration of the photographic session and still have them appear 'natural' is often more difficult than it would seem. Even the shooting of simple herp portraits can sometimes drive you up the wall.

Snakes are difficult to compose because of their linear shape; turtles always stubbornly turn away from the camera, and lizards simply run away. You will have to devise your own methods of harmless restraint.

Even agile snakes can be made to stay still on the ground for a short while by covering them with an inverted basket. The dark and comforting space helps to lull them into a false sense of security. When you are ready to shoot (obviously pre-focussing and exposure determination will help) get someone to slowly lift the basket. Your reward might be a beautifully coiled photogenic snake. If not, try again! However, before you cover the snake make sure that the ground underneath is cool.

COMMENTARY

Much as I like flash, nothing beats daylight for ease and beauty. However, few herps will obligingly sit in the sun for your photography and a hot herp will automatically seek the shade, frustrating your attempts. One way of keeping them from getting too warm too soon is to cast a large enough shadow on the subject till the moment of actually shooting the photograph.

You could also put your subject in the shade to start with and have an assistant shine light off a carefully placed portable silver reflector onto it. Reflected light has a beautiful quality to it when directed from the correct angle. The reflector is a simple device that can add a great deal of beauty to your daylight photography. Sometimes it makes photography possible in impossible situations.

Any piece of cardboard or plywood can be converted into a reflector by the simple act of sticking silver foil onto it. Gift wrapping paper is particularly good for this purpose because it does not throw too harsh a reflection . Whichever paper you use DO NOT paste a single large sheet on the reflector because this will create a hot spot. Use instead, several small pieces and stick them slightly separated from one another to produce a more uniform reflection of light. A reflector can be of practically any size. The larger it is the greater the area it can light up. However, A 4 feet X 3 feet reflector is adequate for most situations. By putting hinges in the centre you can make it foldable.

Is there a formula for successful herp photography? The answer is yes and no. If, say, you are producing a field guide and need excellently lit, clear pictures of various kinds of herps you could develop a basic approach using the same kind of equipment, lighting and background to produce consistently good results with the minimum of trouble. If on the other hand you treat herp photography as an art form you can experiment endlessly. Every photograph then becomes an opportunity to test your skills and imagination.

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CONSERVING REPTILES AND AMPHIBIANS ON THE INDIAN SUBCONTINENT.

SIMON STUART

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IUCN - The World Conservation Union - was founded in 1948 and represents the only federation of govermental and non-govermental organisations working in the environmental field. IUCN is, therefore, in a very real sense the umbrella for the world conservation movement. To provide technical support and advice for its membership, the IUCN runs six Commissions, which are composed of individual experts on various environmental topics. The six Commissions are: the Species Survival Commission; the Commission on Natural Parks and Protected Areas; the Commission on Ecology; the Commission on Sustainable Development; the Commission on Environmental Policy, Law and Administration; and the Commission on Education and Training. The largest of these six commissions is the Species Survival Commission, currently composed of 2,500 members in about 90 Specialist Groups. The Chairmen of the Commissions are elected by the IUCN General Assembly which meets every three years. Other members of the Commissions are appointed by the Commission Chairman after approval by the Council of IUCN. The current Chairman of the SSC is Dr. George Rabb, who is also President of the Chicago Zoological Society.

The SSC is fortunate in having more staff support than any of the other IUCN commissions. At the IUCN Secretariat in Gland, Switzerland there is an Executive Office for the Commission. This is headed by Dr. Stephen Edwards who is Coordinator of IUCN's Species Conservation Programme. I work with Dr. Edwards as Programme Officer for the SSC. Also in the

Executive Office we have an Administrative Officer, Ms. Linette Humphrey. The SSC Chairman, Dr. George Rabb, has also been extremely generous in providing support to the SSC from his own institution. Currently, he has provided two staff Mr. Craig Pugh and Ms. Karin Nelson, who both work very closely with the SSC.

Since it was founded in 1949, the SSC group has grown into a global network which harnesses the skills and insights of experts on the conservation of species, and makes these available to the worldwide conservation movement, thereby promoting the action necessary to arrest the loss of the world's biological diversity and to restore threatened species to safe and productive levels. The principal mechanism by which the SSC works is through its network of Specialist Groups. Most of these groups are oriented along a taxonomic basis, such as the Asian Elephant Specialist Group, the Crocodile Specialist Group, and the Orchid Specialist Group. Some others are also thematic in scope, such as the Captive Breeding Specialist Group, the Veterinary Specialist Group, the Trade Specialist Group, and the Re-introduction Specialist Group. The traditional strength of the SSC has always been with large mammals and with large reptiles. There are three Specialist Groups dealing with reptiles that have a long history of activity: the Crocodile Specialist Group, the Marine Turtle Specialist Group, and the Tortoise and Freshwater Turtle Specialist Group.

However, for some time now, the SSC Steering Committee has been very concerned that the Commission has not been active in the field of amphibian, snake, and lizard conservation. In order to rectify this deficiency, it was decided two years ago to launch a programme of establishing new reptile and amphibian Specialist Groups on a regional basis. These groups are to concentrate on amphibians, snakes, and lizards, leaving the crocodiles, tortoises, and turtles to the already established global groups. So far, three of these Specialist Groups have become operational. These are the European Reptile and Amphibian Group, the African Reptile and Amphibian Group, and the Indian Subcontinent Reptile and Amphibian Group. At the present time, new groups are being planned for South America, North America and Australia.

The Indian Subcontinent Reptile and Amphibian Specialist Group was founded in 1989, when the SSC Chairman asked Mr. Indraneil Das and Dr. S.K. Dutta to assume the Co-Chairmanship of the new group, and to appoint a membership. What then are the roles of the Specialist Groups in general, and the Indian Subcontinent Reptile and Amphibian Group in particular? The general roles of all the Specialist Groups can be summarised as follows:

1 To provide leadership for the conservation of the genetic diversity of the threatened taxa, within the brief of each group.
2 To determine and review on a continuing basis the status and needs of these taxa, and to promote the implementation of necessary research and management measures.
3 To make these known through published books, scientific and popular articles, films, newsletters, symposia and meeting proceedings.
4 To promote the wise management and sustainable utilisation of all taxa within the brief of the group (especially non-threatened species)
5 To ensure the conservation of the taxa through the development and implementation of conservation strategies and specific projects.

In particular, for the Indian Reptile and Amphibian Specialist Group, the activities and responsibilities listed above would be best achieved by preparing a conservation Action Plan for the species within the region. The preparation of an Action Plan for amphibians, snakes and lizards of India, Pakistan, Nepal, Maldives, Bangladesh, Bhutan and Sri Lanka would require the following:

1. A listing of all the species in each of the

countries and regions, at a level of detail that is not too difficult to undertake.

2. Identification of globally threatened species and communities of species, with an indication of the principal threats to those species.
3. An assessment of the degree of urgency for conservation action on either a species by species or site by site basis, or both, whichever is more feasible to do.
4. A list of actions needed to address these conservation problems and to secure the species for the long - term future.

Clearly, this would be ambitious undertaking, but it is one in which I would certainly be willing to seek assistance for the group, providing guidance on development of Action Plans, drawing on experience from several other Specialist Groups.

It is important to realize that SSC Specialist Groups are networks, rather than organisations. The Specialist Groups do not normally have the financial resources to carry out field projects of their own. Normally, this is better left to other organisations and governments. The role of the Specialist Group is to encourage and promote appropriate high priority action on behalf of amphibians, snakes and lizards by those institutions which have a responsibility to do such work. Of course, individual members of a Specialist Group might be working for some of these institutions and government agencies and might actually be involved in the necessary field projects to conserve the species in question. Once the Action Plan has been completed, the group will not have a whole array of priorities and projects that it will be wanting to push among the conservation organizations and agencies within the region, and by that time, IUCN and SSC will have learnt a lot more about promoting the implementation of Action Plans. Promoting Action Plan implementation is in fact one of the highest priorities for the SSC in general over the next three years.

I should point out that although we have more supporting staff than other IUCN Commissions, it is not really possible for us to deal on individual basis with all the 2,500 members of the SSC. Members of Specialist Groups are therefore encouraged to communicate on all matters of importance with their Chairmen (or in your case Co-Chairmen) in the first instance. From this office we retain regular contact with both Mr. Das and Mr. Dutta.

I feel that the Indian Reptile and Amphibian Specialist Group has been established at a very opportune moment. I think there are great opportunities, and I am heartened by the enthusiasm withwhich the group has already got started. Let us not lose sight that our principal objective is to secure the long term survival and recovery of all species of reptiles and amphibians within the Indian Subcontinent, and I am convinced that this new Specialist Group will play a pivotal role in achieving that. However, this will only be successful if all the members of the group and the herpetologists of the Indian subcontinent work together to achieve this important goal.

HAMADRYAD

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